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RUBBER WORLD

NOW IN ITS 67th YEAR

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oft, tough" Butyl rubber
ad after 25,000 miles

RARY

ABRASION OF BUTYL RUBBER

See article by R. L. Zapp, page 59

ILL BROTHERS
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For uniformity in blown closed cell sponge—

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activated with

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EFFECTIVE IN NEOPRENE, GR-S OR NATURAL RUBBER

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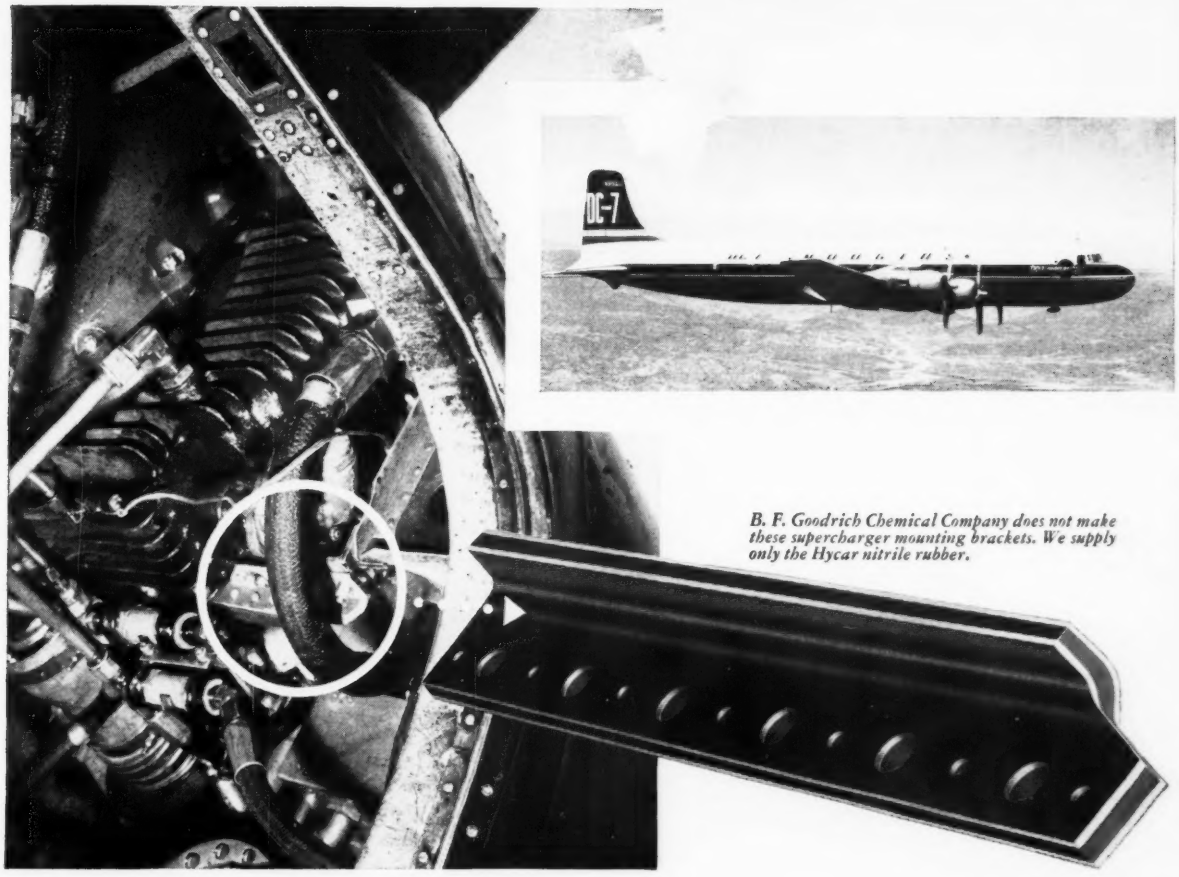
BETTER THINGS FOR BETTER LIVING ... THROUGH CHEMISTRY

RUBBER WORLD, October, 1955, Vol. 133, No. 1. Published monthly by BILL BROTHERS PUBLISHING CORP. Office of Publication, 1309 Noble Street, Philadelphia, Pa., with Editorial and Executive Offices at 386 Fourth Avenue, New York 16, N. Y., U.S.A. Entered as Second Class Matter at the Post Office at Philadelphia, Pa., under the act of March 3, 1879. Subscription United States $5.00 per year; Canada, $6.00; All other countries $7.00; Single Copies 50 cents. Address Mail to N. Y. Office.

Another new development using

B. F. Goodrich Chemical *raw materials*



B. F. Goodrich Chemical Company does not make these supercharger mounting brackets. We supply only the Hycar nitrile rubber.

EVERYBODY BREATHES EASIER AT 15,000 FEET

... with Hycar's help

PARTS inside an aircraft engine nacelle operate in a tough environment. This is where you'll find Hycar —where there is contact with oil, where temperatures run from minus 65 to plus 300, where take-offs and engine runups cause terrific strains and shattering vibration.

Inside the outboard nacelles on DC-6s and DC-7s, Hycar and steel mounting brackets support the 145 pound weight of cabin pressurizing superchargers like the one shown above. Engineers who designed the brackets picked Hycar American rubber as the material that would stand up to the requirements of the job. They made a rubber sandwich of Hycar and steel, shaped it into strong, vibration-absorbing mountings which can take the shear, torque, and compression forces of at least 2000 hours of engine operation.

Products and parts made from Hycar retain their flexibility and strength through wide temperature ranges. They resist abrasive and chemical action. They continue to meet operational requirements even though subject to constant contact with gas and oil.

Hycar is noted, too, for its excellent moldability, permitting manufacture to close tolerances and rigid specifications. For helpful information about what Hycar can do for you in your own operations, please write Dept. CL-10, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

B. F. Goodrich Chemical Company
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The world's outstanding tires are made with Philblack E! Cold rubber treads made with Philblack E hold remarkable records for mileage . . . up to 42% better than tires made with EPC black. And tire manufacturers know *it's performance that counts!*

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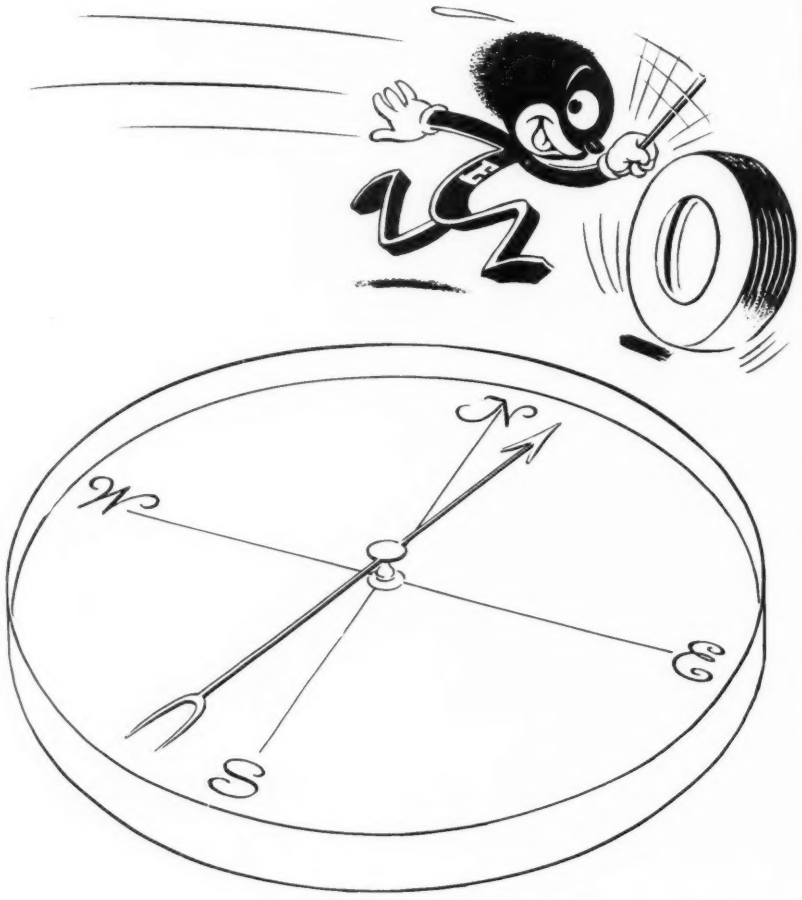

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For long, durable life. Good electrical conductivity. Excellent flex. Fine dispersion.

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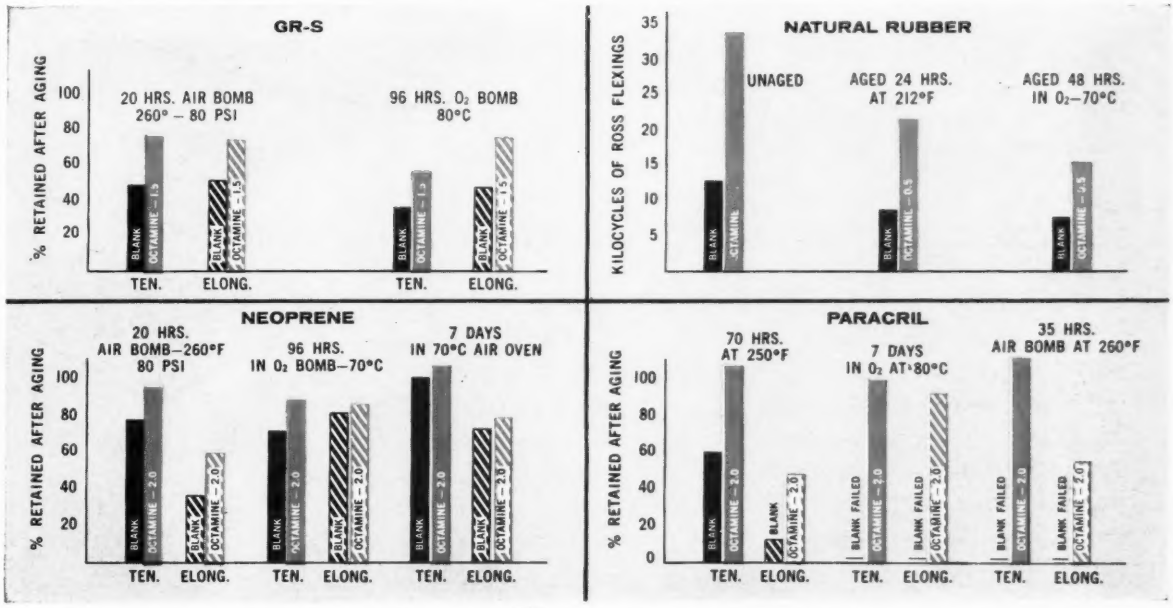
plus protection

minus discoloration



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Why not learn more about the exceptional extrusions you can produce—easier and more economically—with tailored-to-use PLIOVIC resins? Details and samples plus technical help are yours by dropping a note outlining your needs to:

Goodyear, Chemical Division,
Plastics Dept., Akron 16, Ohio

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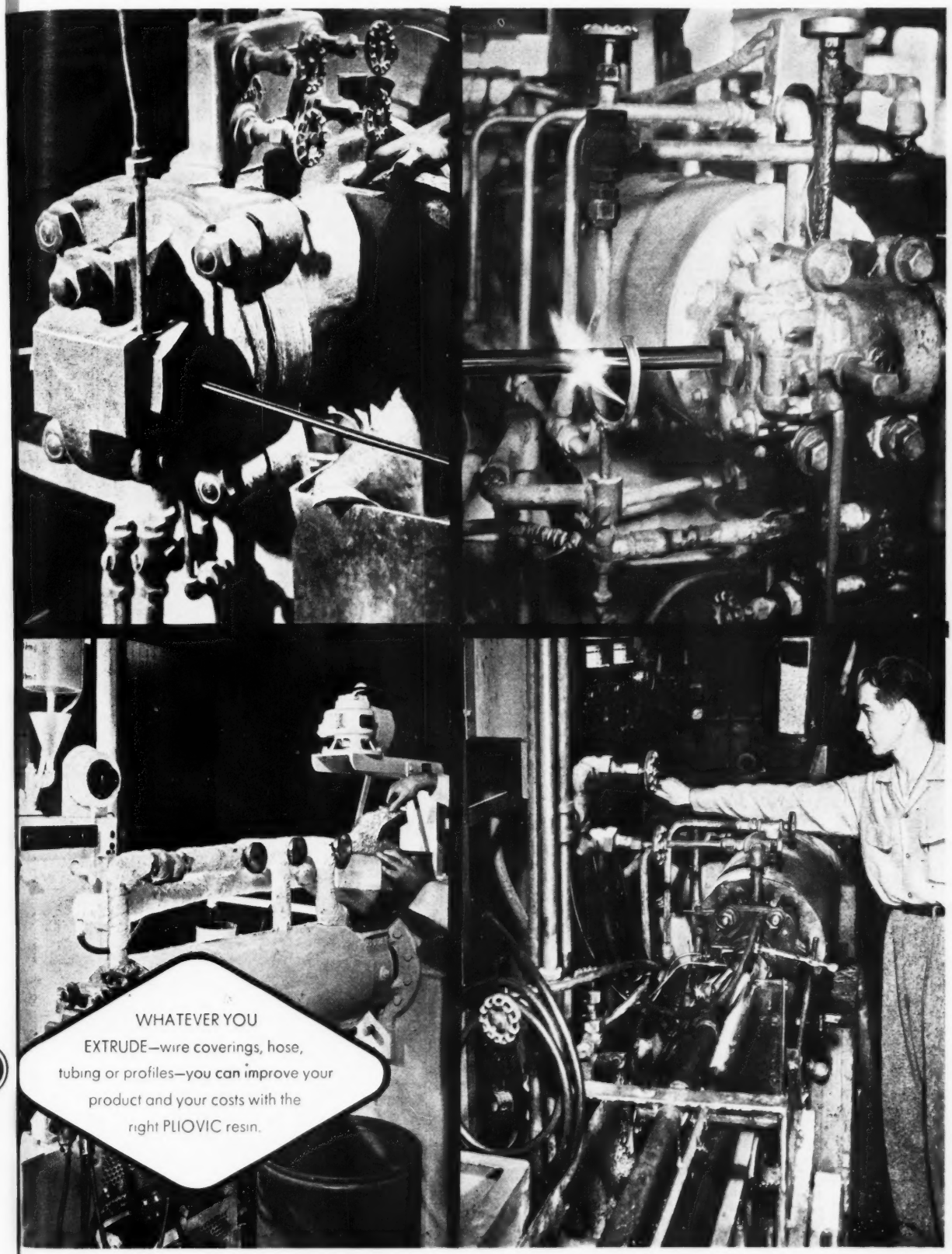
PLIOVIC...another quality product of Goodyear Chemical Division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EXTRUDE—wire coverings, hose,
tubing or profiles—you can improve your
product and your costs with the
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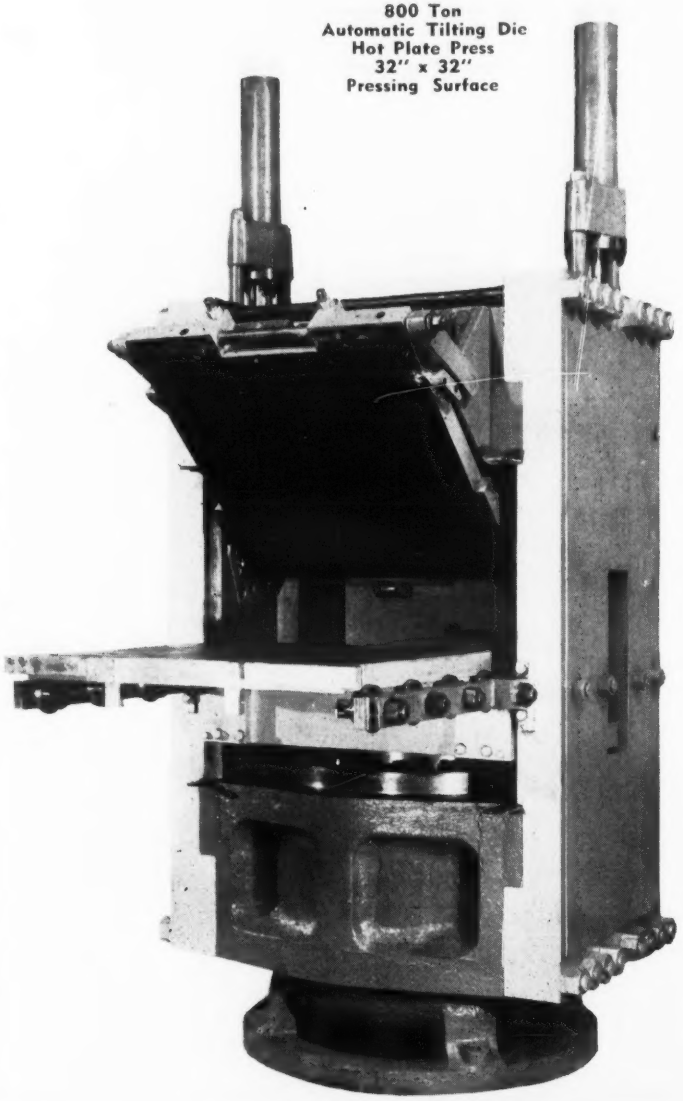

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Whether you store zinc oxide in bags or bins, you can save valuable space with PROTOX-267.*

1. SAVE ON BAG STORAGE

You can cut your oxide storage space and storage costs by as much as 67% with PROTOX-267—because that zinc oxide bulks 80 pounds per cubic foot as against 25–30 pounds for many conventional oxides.

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PROTOX-267 is a "natural" for storing in bins. Its high density saves space; its pellets, like peas on a knife-blade, have a low "angle of repose" and flow fast out of bins.

*U. S. Patents 2,303,329 and 2,303,330.

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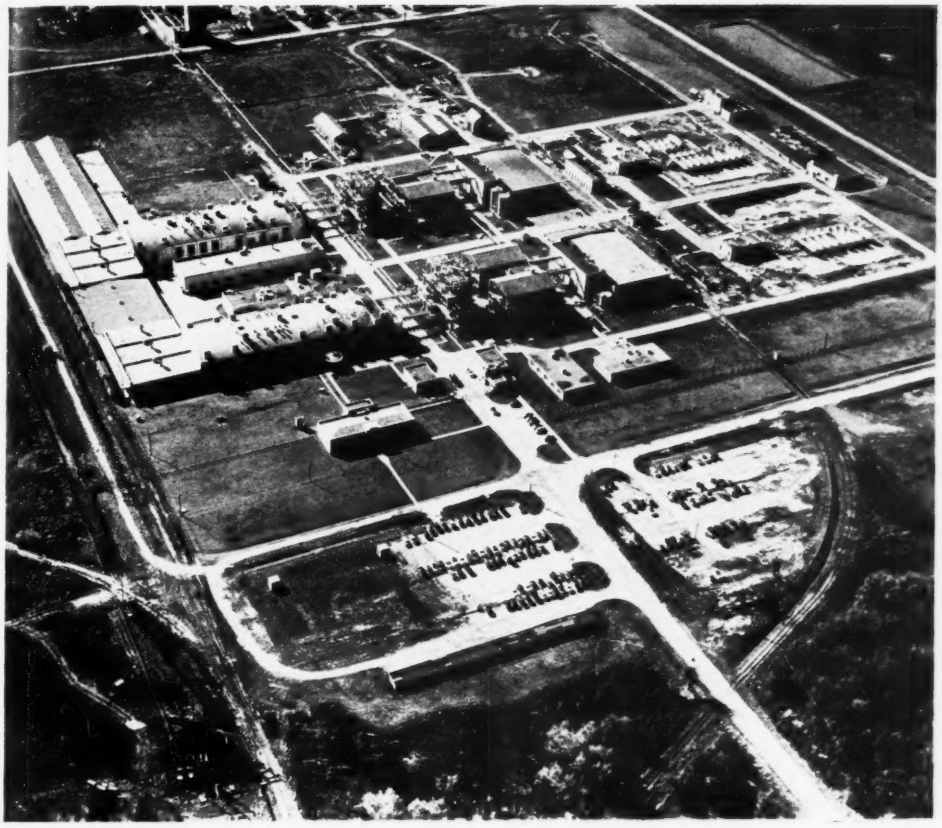
IMPORTANT NAMES to all users of synthetic rubber are these designations for the various types of PLIOFLEX—Goodyear Synthetic Rubber:



PLIOFLEX 1000
—hot, nonpigmented, staining type

•

PLIOFLEX 1006
—hot, nonpigmented, nonstaining type

•

PLIOFLEX 1502
—cold, nonpigmented, nonstaining type

•

PLIOFLEX 1703
—cold, oil masterbatch (25 parts oil), nonstaining type

•

PLIOFLEX 1710
—cold, oil masterbatch (37½ parts oil), staining type

THIS HOME OF QUALITY
is now the home of Plioflex

THIS IS the former GR-S plant in Houston, Texas. Under Government ownership, it established a reputation as the source of unusually high quality rubber. Now, its standards are even higher. Now, it is the home of PLIOFLEX—Goodyear Synthetic Rubber.

PLIOFLEX is the designation for a family of styrene rubbers. These are basically the same rubbers which were in production when the plant changed hands. They are primarily nonstaining in nature and include "hot," "cold" and oil extended types.

But higher quality and uniformity are only two of the differences you'll notice in PLIOFLEX. You'll also find PLIOFLEX brings you complete technical service, improved packaging and rapid, reliable delivery from convenient warehouses in l.c.l. or l.t.l. quantities.

And this is only the beginning! Over 30 years' experience in synthetic rubber and the supply of raw materials to the rubber industry is bound to lead to even greater improvements. Why not learn more about PLIOFLEX? Write on company letterhead, for the free, four-color, 24-page brochure, "PLIOFLEX Rubber," to: Goodyear, Chemical Division, Akron 16, Ohio.

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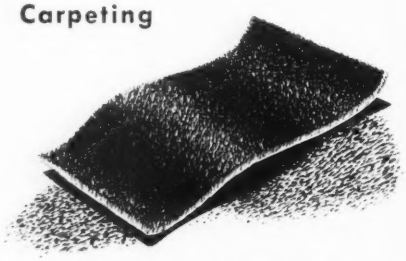
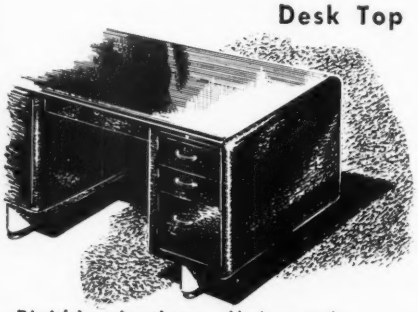
Carpeting



Flocking — Natural or synthetic fibres, ¼ to 1 mm. long, cemented to fabric, paper, rubber, plastics, metals, wood, etc. to produce the effect of pile, suede, velvet or plush.

Desk Top



Rigid Laminating — Linoleum, melamine-type or vinyl plastic top-sheeting permanently bonded to steel and wooden desks.

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Permanent Bonding — High fashion element introduced to TV units through the laminating of colorful vinyl to metal casing.

Tarpaulin

Bonding and Sealing — Canvas tarp sections positioned for stitching with the aid of cement. Later, stitched area is treated with sealer for waterproofing.

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Here you see just a hint of the countless ways Angier Adhesives contribute to the manufacture of U.S. and foreign goods.

Industry has learned to count on Angier for new economy and effectiveness in joining and fastening *all kinds* of materials.

How do adhesives fit into your picture? The answer might prove to be a very profitable surprise. You will never know until you talk to an Angier Products man. May we make an appointment?

Call or write Dept. C at the nearest Angier Plant for personal attention. We will help you define your problem as well as solve it. Inquiring will not obligate you in any way.

Angier Products

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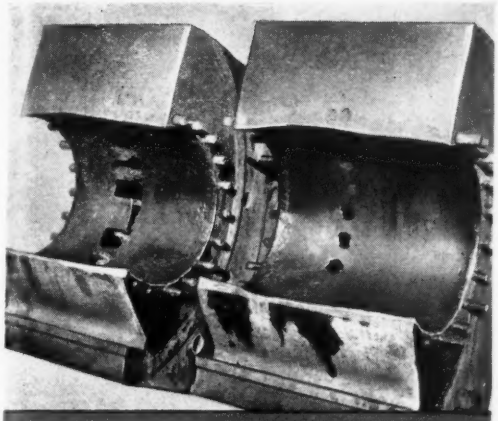
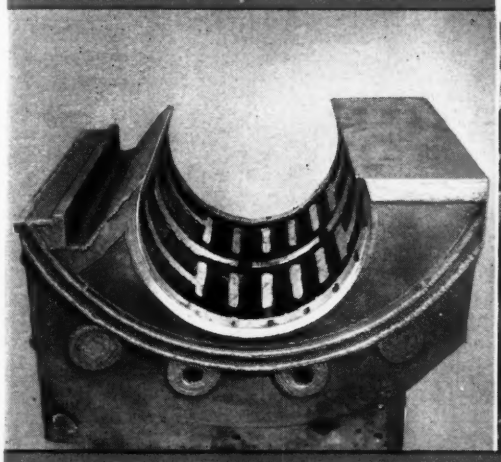


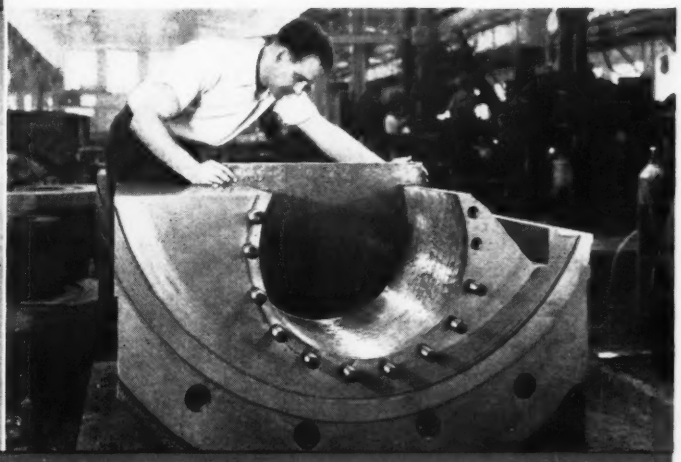
Badly worn Banbury sides returned for rebuilding.

EVIDENCE

that it pays to have your Banbury® repairs done by Farrel-Birmingham



Side has been bored, ready for a wear-resistant liner to be welded in.



New liner getting final gauging after having been finished to exact size.

As you can see from these photos, Farrel-Birmingham can salvage badly worn Banbury mixer sides by boring, and then welding in new, extremely wear-resistant, special-alloy liners, which are finished to exact final dimensions. When rebuilt, the side is as good as new and carries the same guarantee.

To keep your Banbury shutdown to a minimum, exchanges of bodies can be handled in either of two ways:

1. For fastest service you can "swap" your worn Banbury body for a new one out of Farrel-Birmingham stock. We carry large stocks of new bodies at our Buffalo plant for shipment to western points and at our Derby plant for shipment to eastern points.
2. When you can plan your shutdown period a sufficient time ahead, we can reserve for you a rebuilt body from the number that is continually "in process" at our Derby plant.

When you need Banbury repairs or rebuilding, make sure you get the kind of job that will give you new Banbury performance. Call the Farrel-Birmingham office nearest you.

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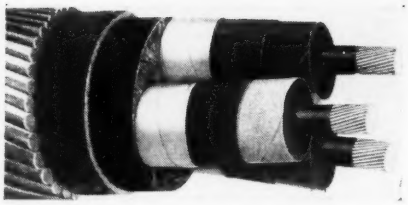
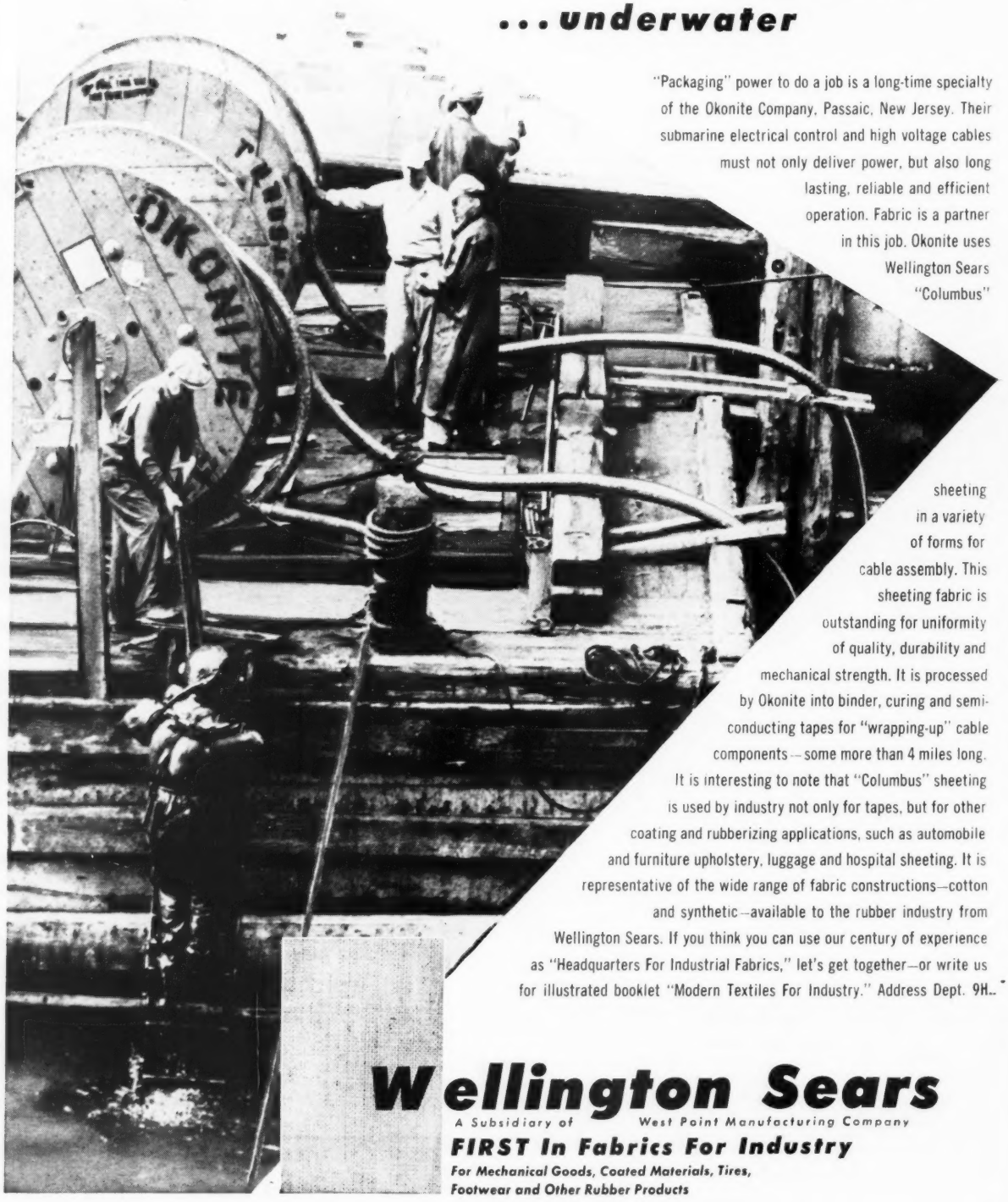
FB-1034

Farrel-Birmingham®

Fabric helps keep power under wraps ...underwater



Three different kinds of fabric tapes are used in this Okonite high voltage power cable.



"Packaging" power to do a job is a long-time specialty of the Okonite Company, Passaic, New Jersey. Their submarine electrical control and high voltage cables must not only deliver power, but also long lasting, reliable and efficient operation. Fabric is a partner in this job. Okonite uses Wellington Sears "Columbus" sheeting in a variety of forms for cable assembly. This sheeting fabric is outstanding for uniformity of quality, durability and mechanical strength. It is processed by Okonite into binder, curing and semi-conducting tapes for "wrapping-up" cable components—some more than 4 miles long. It is interesting to note that "Columbus" sheeting is used by industry not only for tapes, but for other coating and rubberizing applications, such as automobile and furniture upholstery, luggage and hospital sheeting. It is representative of the wide range of fabric constructions—cotton and synthetic—available to the rubber industry from Wellington Sears. If you think you can use our century of experience as "Headquarters For Industrial Fabrics," let's get together—or write us for illustrated booklet "Modern Textiles For Industry." Address Dept. 9H.

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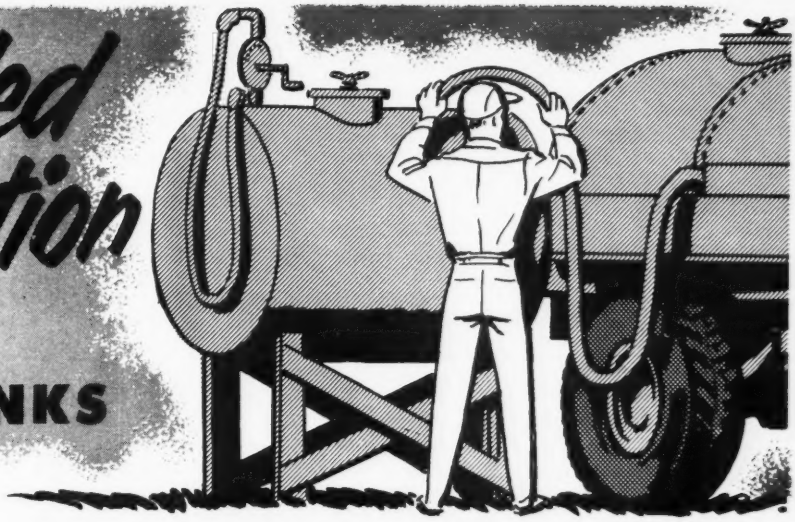

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the two coat Adhesive System for bonding Natural Rubber and GR-S Compounds

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Division of BORG-WARNER

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TY-PLY has stood the test of time . . . since '39

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. . . an important factor in the S.C.S.* Method of Rebuilding BANBURY MIXERS

SECO
ESTABLISHED 1868

* S. C. S. means Skinner Certified Service. One important factor in the rebuilding of Banbury Mixers is the proper equipment to do what needs to be done, with dispatch and precision. Expert craftsmen use the most improved machine tools for turning, boring, milling, and other necessary operations. Searching inspection and rigid testing are routine procedures throughout the rebuilding job.

Re-cutting registers and restoring standard length dimension for No. 11 spray sides on 120-in. King Vertical Mill. This is one of the large heavy duty machine tools in the SKINNER plant used in rebuilding Banbury Mixers.

A *few* POINTERS ON S. C. S.

- All rebuildable parts of dismantled body are checked for hidden imperfections, for standard dimensions and distortion.
- Sides are bored out, and 2-in. liners of customer's choice installed.
- Rotors are completely stripped of hard-surfacing materials, and bodies rebuilt to proper contour. Entire rotor, inclusive of threads, is rebuilt, body hard surfaced, stress relieved, and restored to standard dimensions.
- Sliding door, dust seal rings, and body fit bolts are always provided new.
- All parts are carefully examined by skilled technicians and magnafluxed.

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SECO ESTABLISHED 1868

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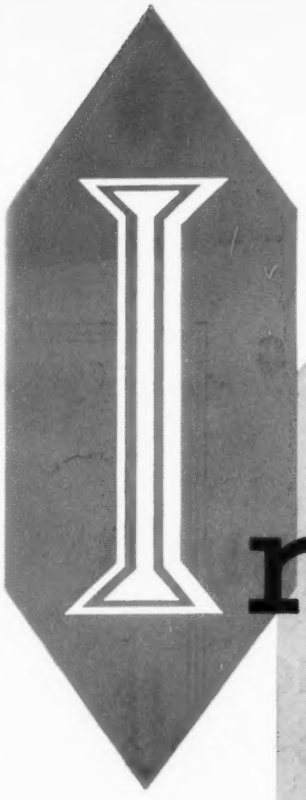

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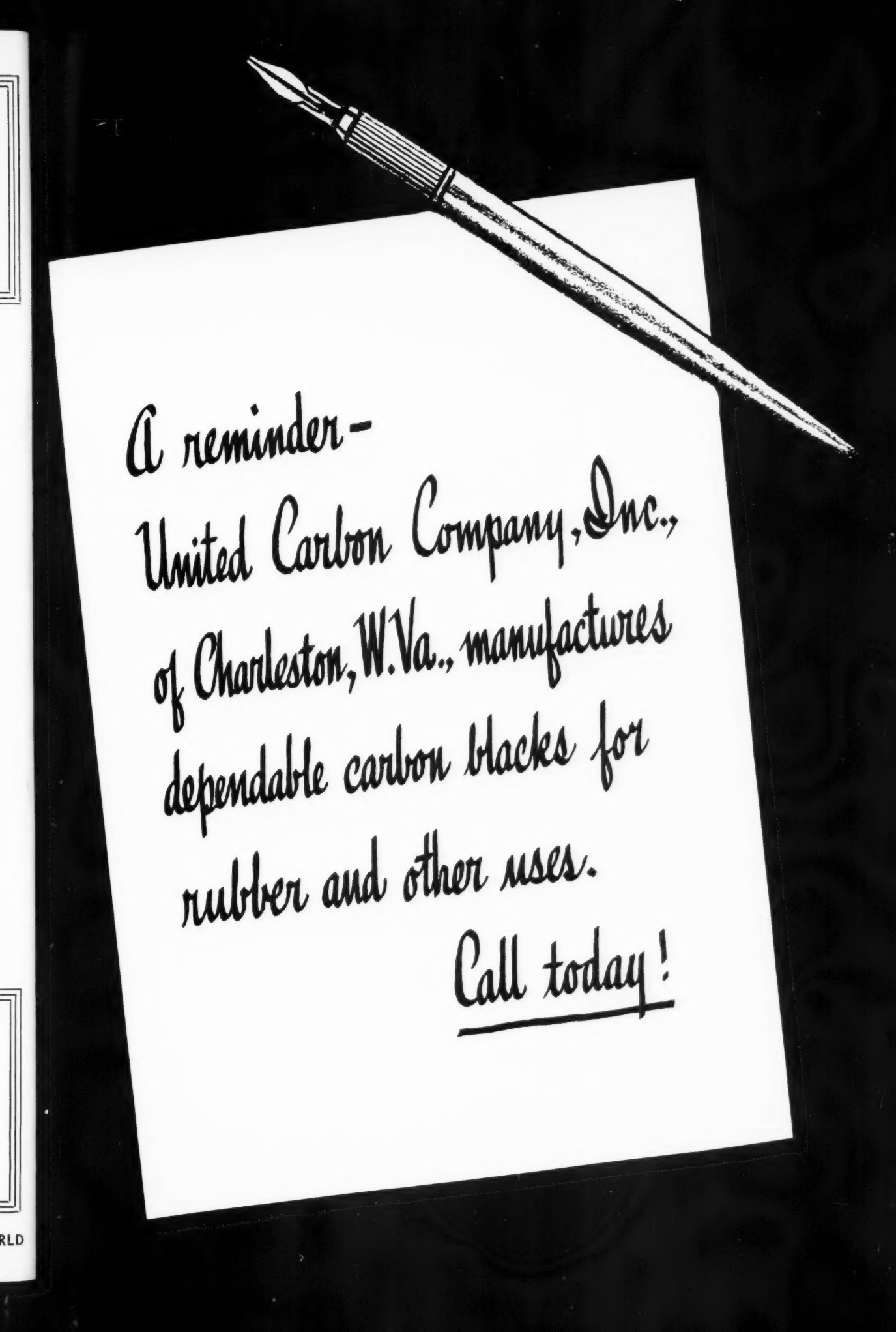
13813 TRISKETT ROAD
CLEVELAND 11, OHIO


A reminder-
United Carbon Company, Inc.,
of Charleston, W.Va., manufactures
dependable carbon blacks for
rubber and other uses.
Call today!

KOSMOS 20

Kosmos 20, Semi-Reinforcing (SRF) furnace black, boasts by far the widest applications in various types of rubbers, and is indispensable to ever so many compounders.

Kosmos 20 is non-staining and is most uniform. It is characterized by high loading capacity; easy and smooth processing; softness; a good balance of tensile, modulus, and high resilience; low heat build-up; high resistance to flexing; and improved aging – all this plus low volume cost.

Kosmos blacks are in the front for unsurpassed performance. It is wise to standardize on United blacks and stay in the lead.

UNITED CARBON COMPANY, INC.

A subsidiary of United Carbon Company

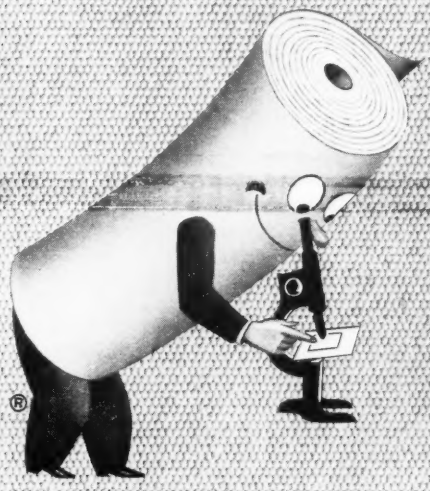
CHARLESTON 27, WEST VIRGINIA

NEW YORK AKRON CHICAGO BOSTON MEMPHIS

UNIFORMITY

Makes The Big Difference In

INDUSTRIAL FABRICS



MT. VERNON FABRICS

Give You Greater Uniformity

FABRICS ENGINEERED TO FIT YOUR NEEDS – Need adaptation of an existing fabric to your special purposes? Or creation of an entirely NEW fabric – cotton, synthetic or blend – to meet your specifications? Mt. Vernon-Woodberry's staff of textile engineers is available on request to help you with your problems in development or application of industrial fabrics.

Mt. Vernon-Woodberry Mills

TURNER HALSEY COMPANY
Selling Agents

Main Office: 40 Worth St. • New York

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One of a series of comprehensive laboratory controls throughout production to assure uniformity in all Mt. Vernon-Woodberry products. Here fabric thickness after weaving is being gauged.

improves **ELONGATION**

gives lower modulus and better cut-growth resistance

PARA RESIN 2457

Para Resin 2457 is a dark-colored petroleum base resin. Its softening point, between 200-220° F, lends itself to good dispersion. It improves the flow of extrusion stocks and gives smooth calendered stocks. Because of its low specific gravity and volume cost, it is an economical compounding ingredient for mechanical goods. Tests against other resins have proven Para Resin 2457 to be far superior in every way. More and more manufacturers of mechanical goods are turning to Para Resin 2457 for improvement in product quality at lowered unit cost. Try it in your products.

Testing a free sample may save you many, many dollars. You owe it to your products to give it a trial.

The C. P. Hall Co.
CHEMICAL MANUFACTURERS

AKRON, OHIO
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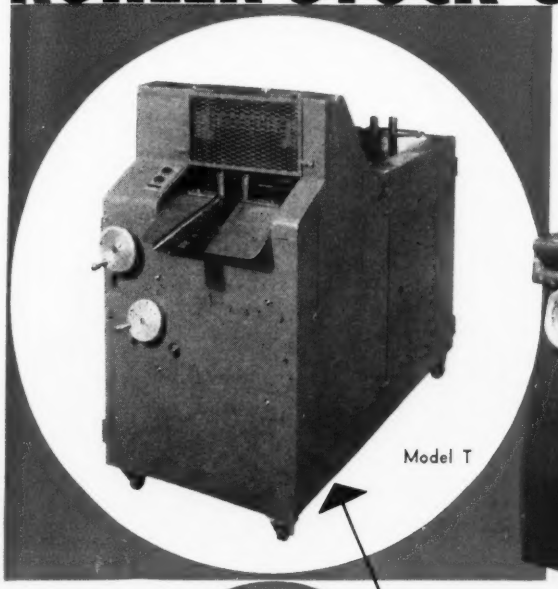
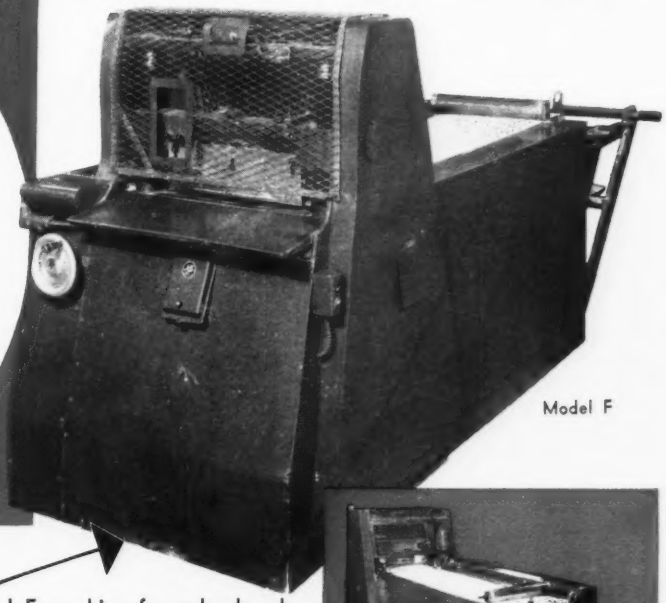
CUT COSTS! CUT TIME! CUT WASTE!

KOHLER STOCK CUTTING MACHINES

Guillotine type for flat or tubular stock



Model T



Model F

OUTSTANDING FOR CONTROLLED ACCURACY

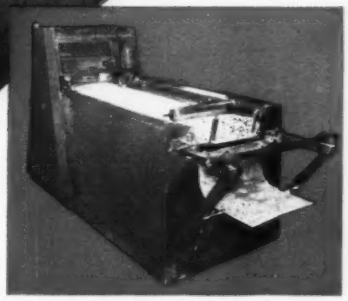
SYNCHRONIZED POSITIVE MECHANICAL DRIVE

ADJUSTABLE WHILE IN MOTION

Model F machine for calendared or flat stock. Built in conveyor. Pivoting blade available for diagonal cuts.

Model T machine. Use with tubing machine or like. Continuous feed.

These machines can be seen in operation, anytime. Call for appointment.



Rear view of Model F machine.

THERE IS NO MACHINE ON THE MARKET WHICH CAN CUT WITH THE ACCURACY OF KOHLER MACHINES.

KOHLER CUTTERS FEATURE

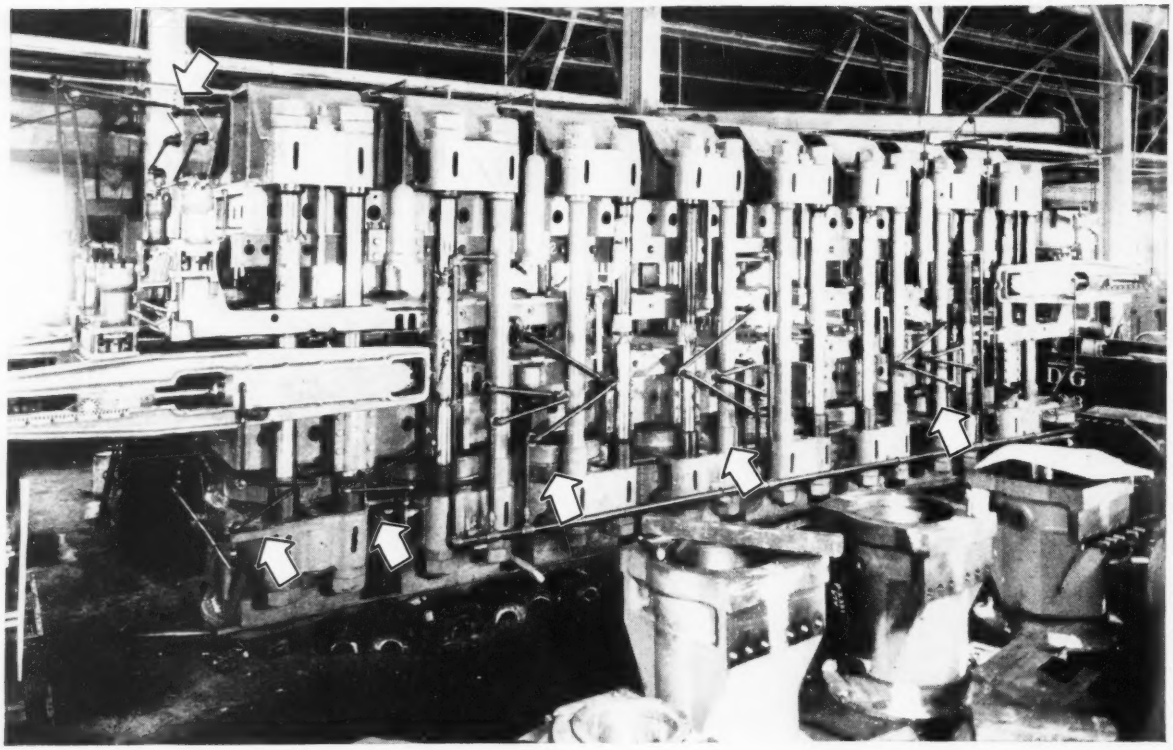
- Continuous feed
- Handles flat or tubular stock, cured or uncured
- Dual feed, top and bottom surface contact
- Compensated take-up to handle any thickness
- Will accommodate extruded, milled, calendared, or most any stock
- Adjustable speed and cut length, in motion
- Available with switch blades for alternate diagonal cuts
- Available with roll feed, belt feed, or both
- Vernier controlled adjustments
- Models and sizes to handle any job

CALL ON US FOR CUTTERS, CONVEYORS, MOLDS, TRIMMERS AND BUFFERS

KOHLER MOLD and MACHINE CO.

1335 Kenmore Blvd. **Akron 6, Ohio**

SELF-ALIGNING **BARCO** SWIVEL JOINTS



Eight Presses in One to Vulcanize Belts!*

Adamson United Company of Akron, Ohio, has amassed a vast background of engineering "know how" about building complicated presses for the rubber industry. Adamson United's experience has included many and varied uses of *self-aligning* Barco Swivel Joints for making flexible piping connections to moving or movable machine parts.

The press shown above makes heavy material handling belts. Twelve ½" or ¾" *Series 600* Barco Swivel Joints are used on 2000 psi hydraulic lines (at left end) and ¾" *Standard Series* joints with 11CTS gaskets are used on 175 psi steam and condensate drain lines leading to the eight* sections of platens along the sides of the press. All are in "dog-leg" assemblies with three joints and two lengths of pipe in each assembly.

Barco builds a complete line of swivel joints for every purpose. Ratings as high as 600°F., 3,000 psi (hydraulic). Sizes ¼" to 2"; angle or straight. *For complete information and recommendations, see our nearest representative or write.*

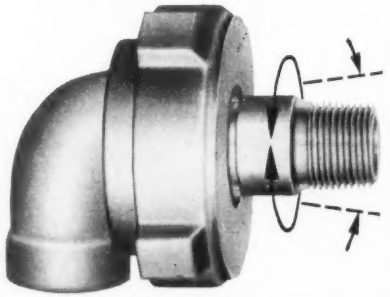
**Other Adamson United multiple presses use as many as twenty presses in combination.*

BARCO *Manufacturing Co.*

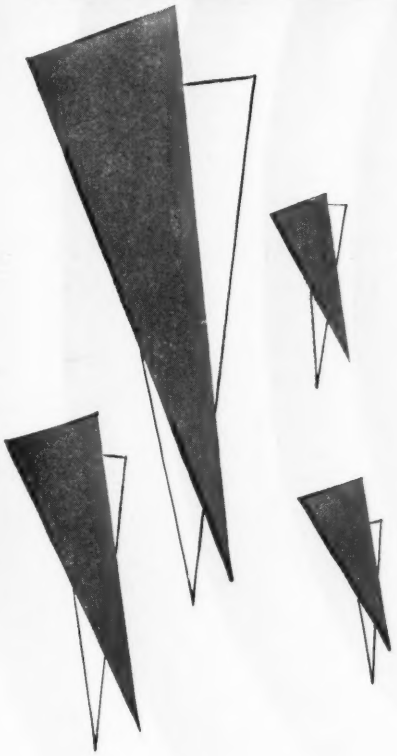
510L North Hough Street • Barrington, Illinois

USED BY LEADING MACHINE BUILDERS

- **IMPROVED SEAL**—Barco's new No. 11CTS gasket is amazingly long wearing! Does not bake hard. Ideal for steam and water service. Does not cause excess wear on other parts.
- **LEAKPROOF, HOT OR COLD** — Joints stay tight regardless of pressure or temperature.
- **SELF-ALIGNING** — 10° side flexibility. This Barco feature saves piping time, cuts costs, and insures perfect performance.
- **ENGINEERING RECOMMENDATIONS**— Send for a copy of Catalog No. 265A and installation drawing 10-52004.



to help you select



SHELL DUTREX

PLASTICIZERS and EXTENDERS

For GR-S and Natural Rubber

General purpose applications

Dutrex 6
Dutrex 7
Dutrex 6H (SPX-97)
Dutrex 20
Dutrex 15E
Dutrex 15W

Non-staining or light colored stocks

Dutrex 39
Dutrex 32

For Butyl Rubber

Dutrex 31
Dutrex 32

For Nitrile Rubber

Dutrex 21
Dutrex 25

For Neoprene W types

Dutrex 6
Dutrex 20

SHELL OIL COMPANY

50 West 50th Street, New York 20, New York
100 Bush Street, San Francisco 6, California

SHELL

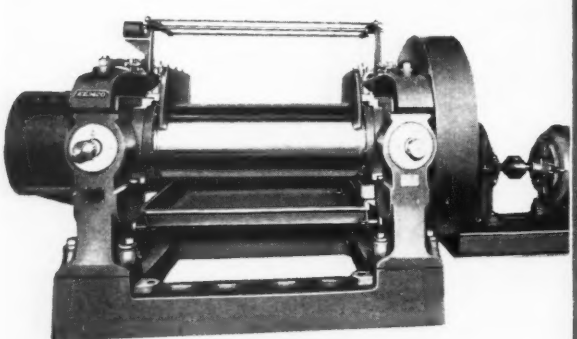
Consult ERIE ENGINE & MFG. CO.

for prices and delivery

MILLS • •

for the RUBBER and PLASTICS INDUSTRIES

EEMCO mills for mixing and compounding rubber and plastics are available in all sizes from laboratory mills up to and including 84" mills in standard or custom units.

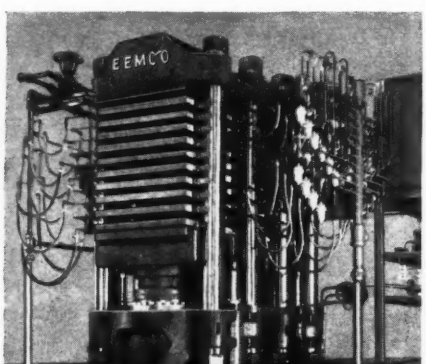


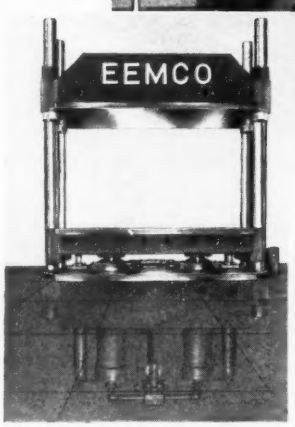
HYDRAULIC • • PRESSES

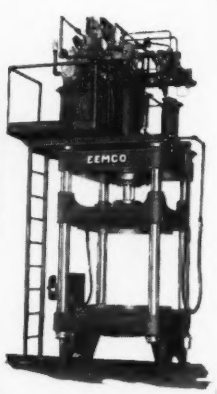
for RUBBER and PLASTICS PROCESSING

REINFORCED PLASTICS MOLDING

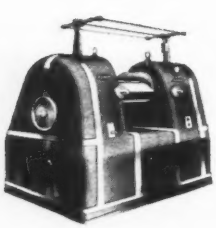
EEMCO heavy duty hydraulic presses are also available in a complete range of sizes from the 12" x 12" 42 ton laboratory press up to any size required. EEMCO designs and builds special presses to meet the customer's requirements.







EEMCO furnishes complete installations for reinforced plastics molding—presses, hydraulic units, preform machines, roving cutters and ovens.



Call or write us for complete details. We will be glad to discuss your "Mill and Press problems"—of course, at no obligation to yourself.

EEMCO **ERIE ENGINE & MFG. CO.**

12th STREET and EAST AVENUE • ERIE, PA.

MILLS • PRESSES • LOADERS • LIFT TABLES • PLATENS • PREFORM MACHINES • ROVING CUTTERS

DELIBERATELY DESIGNED TO CONTROL CRACKING

A POTENT ANTI-OZIDANT

- *HIGHEST QUALITY*
- *FINEST PURITY*
- *CONTROLLED UNIFORMITY*
- *HEAT STABLE*
- *PROTECTION UNDER BOTH STATIC AND DYNAMIC EXPOSURE*
- *IDEAL MIGRATION RATE IN ELASTOMERS*

FOR FURTHER INFORMATION ON COMPLETE CONTROL OF OZONE CRACKING WRITE:

PRODUCTS DEPARTMENT

UNIVERSAL OIL PRODUCTS COMPANY

30 ALGONQUIN ROAD, DES PLAINES, ILL., U.S.A.

when
it
rains
it
shines
. . . rainwear, that is—when it is made bright and white with
TITANOX® white pigments. For all types of rubber and plastics.

TITANIUM PIGMENT CORPORATION • 111 BROADWAY, N. Y. 6, N. Y.
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Pyratex

a new cord treatment for new tire toughness!

Naugatuck – developer of the first natural latex for tire cord treatment, then the first reclaim dispersion, and later GR-S plus Resorcinal – now offers you a special vinyl pyridine latex that increases rubber-to-fabric adhesion up to 50%!

New Pyratex

- binds rayon to rubber with a grip almost as strong as the cord itself.
- retains its outstanding adhesion even under the severe heat and flexing of high-speed tire travel.

What's more, this superior solutioning agent . . .

- develops adhesion more rapidly with cure.
- greatly reduces "curing blows."
- is supplied at higher solids with resulting conveniences.

You'll find Pyratex will raise the performance of reinforced rubber in airplane, truck, bus, and automobile tires, in V-belts and conveyor belts—*wherever* fatigue resistance and ply separation pose problems.

New Pyratex is available for your own further compounding, or as a **Lotol, custom-compounded and ready to use—with good storage stability.** To find out more about how it can help your product—economically—write on your letterhead to the address below.

NAUGATUCK

Division of United States Rubber Company
Naugatuck, Connecticut

US RUBBER

IN CANADA: NAUGATUCK CHEMICALS DIVISION • Dominion Rubber Company, Limited, Elmira, Ontario
RUBBER CHEMICALS • SYNTHETIC RUBBER • PLASTICS • AGRICULTURAL CHEMICALS • RECLAIMED RUBBER • LATICES • Cable Address: Rubexport, N.Y.

another

ST. JOE

"first"

surface-treated

ZnO pellets

Photo of St. Joe surface-treated Zinc Oxide in pellet form, actual size.

PELLETIZED ZnO NORMAL ZnO

(Note reduction in storage space required)

THE ST. JOSEPH LEAD COMPANY is now ready to ship ST. JOE surface-treated ZINC OXIDE in pellet form to consumers in the rubber industry. This "new look" in our product has been worked out successfully with a number of our customers. They have adopted it for all their shipments because – after repeated factory tests – the use of ST. JOE surface-treated ZINC OXIDE in the new pellet form was found to offer the consumer these definite advantages:

- *Free-flowing—improved handling properties*
- *Freedom from dustiness—better plant housekeeping*
- *Faster incorporation in rubber*
- *Superior dispersion in rubber*
- *Less storage space required owing to 50% increase in apparent density*

For your next shipment, specify ST. JOE surface-treated ZINC OXIDE in PELLET FORM

ST. JOSEPH LEAD COMPANY

250 PARK AVENUE, NEW YORK 17 *Plant & Laboratory, Monaca (Josephtown) Pa.*

FOR ✔BETTER MIXING
✔BETTER EXTRUSION
✔BETTER CALENDERING

with Improved Mold Definition and Smoother Surface Finish plus

PRODUCTION ECONOMY

YOU GET THEM ALL WITH . . .

VULCANIZED VEGETABLE OILS

(RUBBER SUBSTITUTES)

RUBBER SUBSTITUTES can give you better results in processing with economy in production . . . There are many grades to serve in many different types of compounds of natural, reclaim and synthetic rubbers — and to provide varying properties. These vulcanized vegetable oils are non-thermoplastic, resilient solids which are readily dispersed in rubber compounds either by mill or Banbury. There are white grades for white or light colored products, brown grades for use in compounds where light color is not a requirement, and in modified brown grades containing plasticizers and fillers.

As Processing Aids

Rubber Substitutes aid processing by giving better mixing, extrusion and calendering, and good dimensional stability in soft stocks.

As Extenders

Rubber Substitutes help extend the higher cost oil-resistant synthetic rubbers and improve their rubber-like qualities.

As Softeners

Rubber Substitutes serve well as polymeric plasticizers and softeners.

For Improved Properties

Rubber Substitutes will improve oil, ozone and light resistance of many stocks, give better mold definition and provide smoother surface finish.

Write to nearest office for complete data

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The
CARTER BELL MFG. CO.

HARWICK STANDARD CHEMICAL CO.

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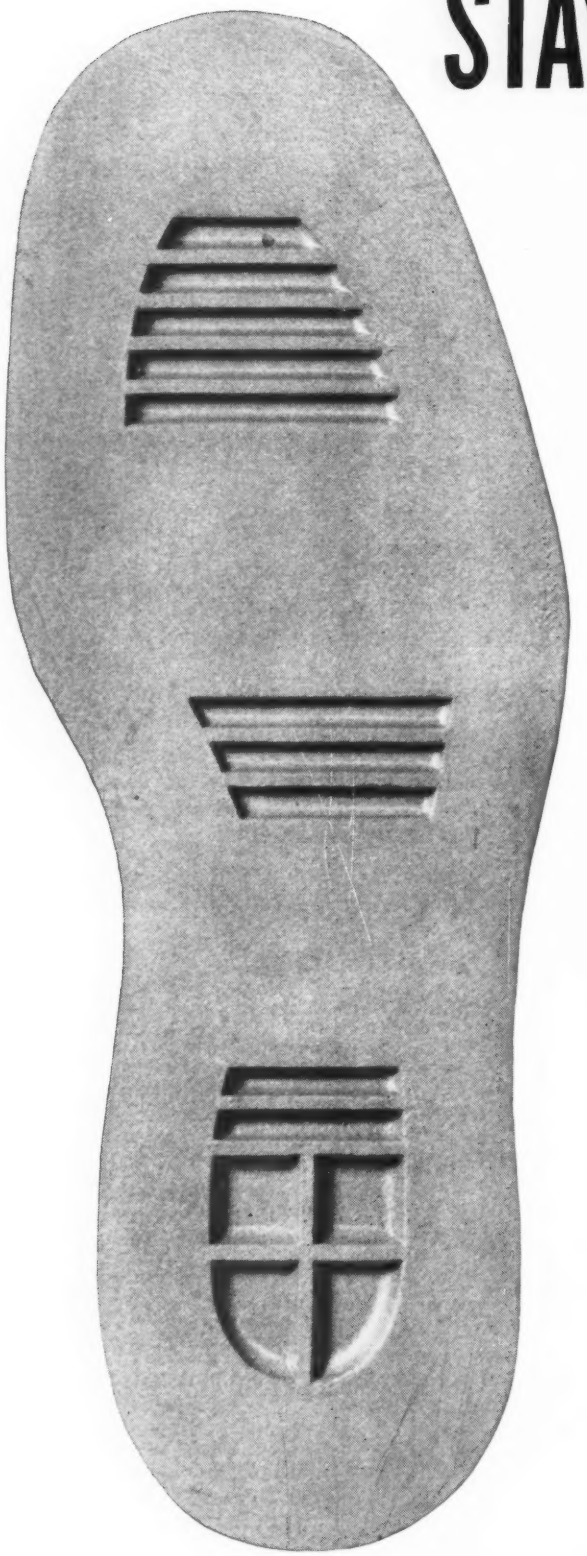
MILLIONS OF SOLES SAVED BY STAYBELITE® RESIN



Rejects are lost soles, but by providing better control over the production of conventional and expanded rubber soling, Hercules Staybelite Resin can help keep your reject ratio to a minimum.

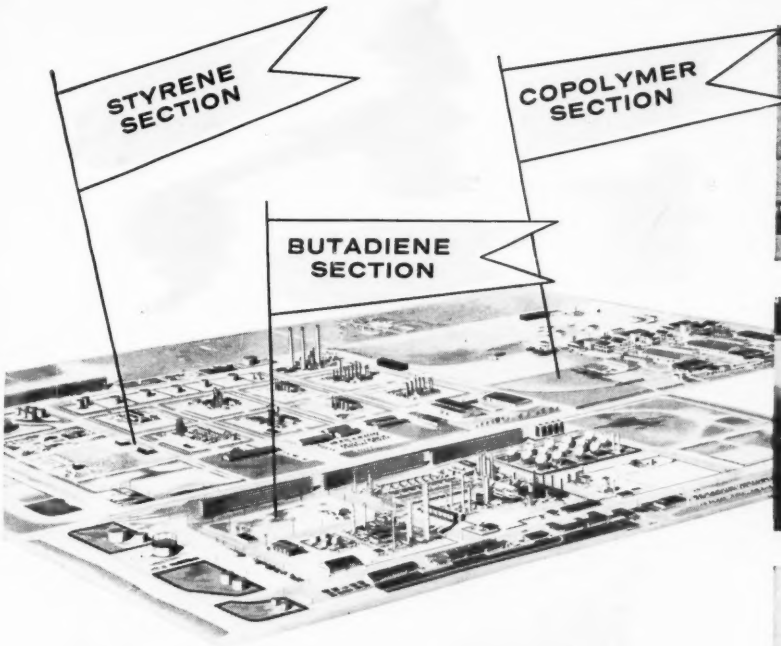
Staybelite gives a stringy kind of tenacity to uncured and semi-cured rubber which provides improved control over processing. And its pigment dispersing ability means more starting points, more uniform cell structure, and more "blow" with a given amount of gas-producing material.

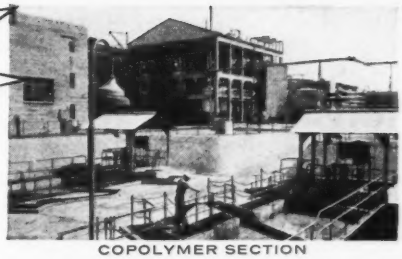
Staybelite's resistance to oxidation, its pale color, and lack of odor make it ideal as a processing aid for all types of soling and heels. In some cases, the presence of Staybelite in the formulation materially reduces objectionable odors caused by other necessary materials.

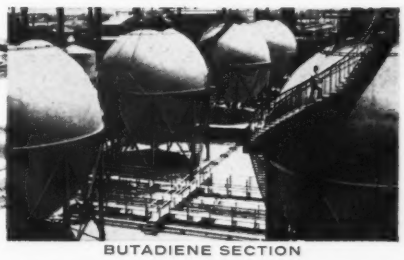
For information on the diversified uses of Staybelite Resin in rubber compounding, write for technical booklet.

Naval Stores Department
HERCULES POWDER COMPANY
INCORPORATED
914 Market Street, Wilmington 99, Del.

IR54-2




COPOLYMER SECTION

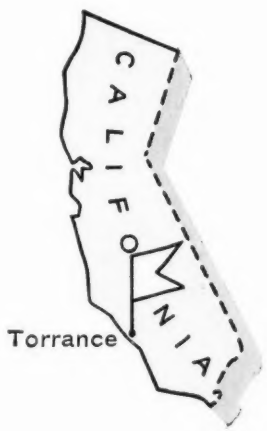

BUTADIENE SECTION

STYRENE SECTION

In the West...

Here's the handy source of

Synthetic Rubber



Shell Chemical offers a wide line of general-purpose polymers

Torrance, California, deserves a big star on your map of rubber sources. It's the home of Shell Chemical's synthetic rubber plant . . . one of the nation's best equipped for the production of a variety of types of butadiene-styrene rubber.

Whether you need a bale or a carload . . . for sheeting, molded goods, extruded goods, tires or other uses, Shell Chemical can fill your requirements promptly.

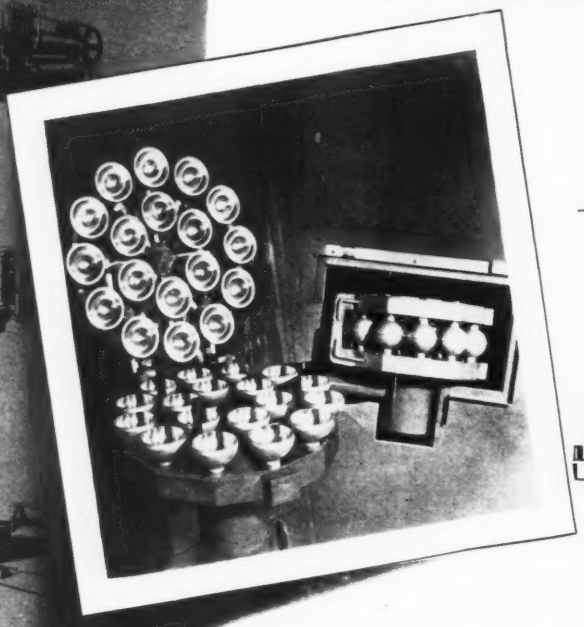
Our technical staff will be glad to discuss your needs. Phone or write Synthetic Rubber Sales Division, P.O. Box 216, Torrance, California. Phone PLymouth 6-1491 or DAvis 4-4991.

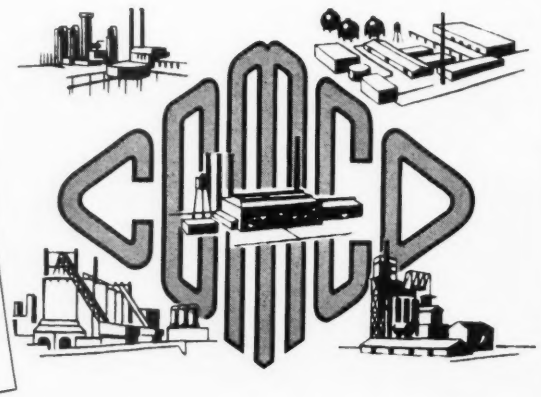
SHELL CHEMICAL CORPORATION

Synthetic Rubber Sales Division

P. O. Box 216, Torrance, California

SHELL





NEW PRODUCTS CREATE BUSINESS FOR RUBBER MANUFACTURERS

Opening up a new field in Plastisols, this high production rotational casting machine, pictured above, is being enthusiastically received by progressive managements. It permits the molding of *any* hollow article.

Completely new hollow, molded playballs, drug sundries, toys and automotive parts made from Plastisols give better product appeal.

Whatever your product, our experience can help its development. Besides furnishing the machines, molds and the dispensing units, our facilities include product design and engineering.

If you are in need of a machine or an item of special equipment, if you intend expanding your facilities or plan entering new fields of manufacture, consult us first. We supply all machinery and equipment for every requirement of large and small factories.

CMCD Integrated Service provides complete design, layout and construction supervision for rubber, plastics and chemical plants, process engineering, technical service and raw material sources.

Continental Machinery Company, Inc.

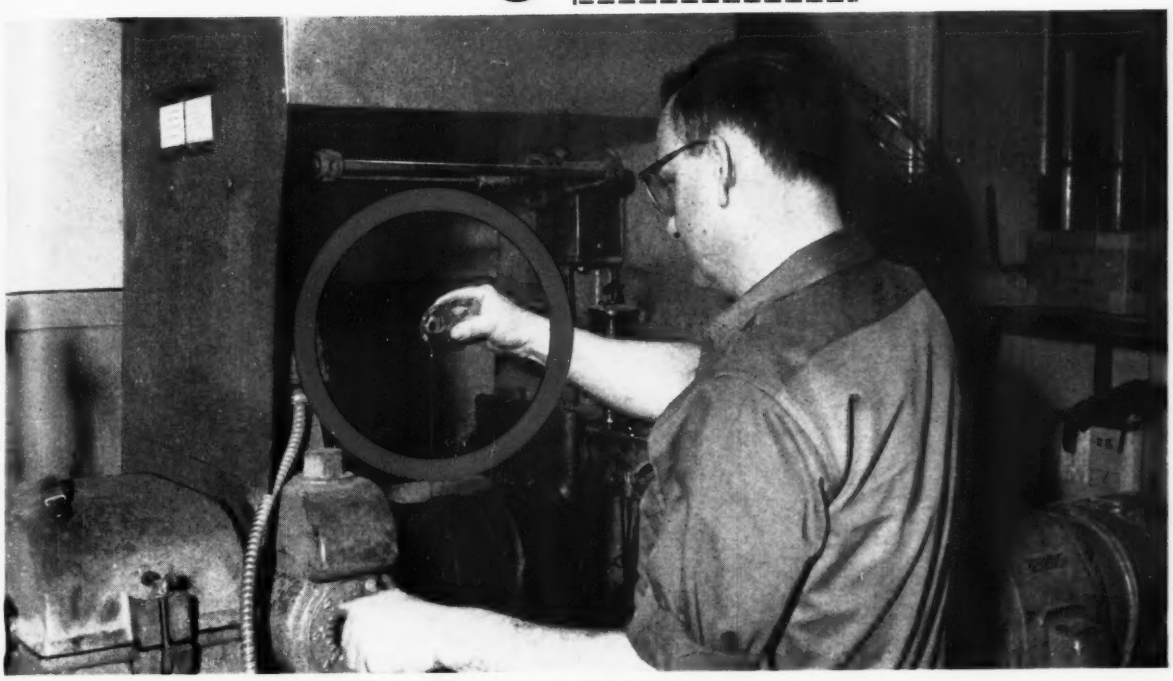
AND

ASSOCIATED ENGINEERS AND ARCHITECTS

261 BROADWAY, NEW YORK 7, N. Y.

TELEPHONE: WORTH 2-1650 • CABLE: "CONTIMAC" NEW YORK

Announcing VA-7



... an economical vulcanizing agent for heat-resistant, non-blooming stocks

VA-7 is a new liquid vulcanizing agent for all types of unsaturated elastomers. It provides economical "sulfurless" cures for nitrile, GR-S and natural rubber stocks.

Stocks compounded with VA-7 display an outstanding combination of heat aging resistance . . . . high tensile strengths . . . . good hot compression set resistance . . . . and non-blooming characteristics in the cured and uncured states.

VA-7 also offers processing advantages—it can be dispersed more easily and uniformly than sulfur. Stable emulsions for curing latices can easily be prepared from VA-7.

The moderate price of VA-7 is another feature that makes this product worth your investigation. *Try VA-7 for heat-resistant, non-blooming stocks at reasonable cost!*

For compounding information and a sample of VA-7 fill out and mail the handy coupon.

CHECK LIST OF VA-7 PROPERTIES

Outstanding heat aging resistance
Non-blooming in cured or uncured state
High strengths at low concentrations
Easy and uniform dispersion
Good hot compression set
Moderate price

THIOKOL CHEMICAL CORPORATION
780 N. Clinton Avenue
Trenton 7, New Jersey

Please send me compounding information ☐
and a sample of VA-7 ☐

NAME _____ FUNCTION _____
COMPANY _____
STREET _____
CITY AND ZONE _____ STATE _____

Thiokol® Chemical Corporation

SYNTHETIC RUBBERS • PLASTICIZERS • CHEMICALS • ROCKET MOTORS

780 NORTH CLINTON AVENUE • TRENTON 7, NEW JERSEY

In Canada: Naugatuck Chemicals Division, Dominion Rubber Company, Elmira, Ontario

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Engineers and Builders of Processes and Complete Plants

Consultants for Rubber and Plastic . . .

offer

PROCESSES AND COST SURVEYS

1 **Critical Appraisal** of existing processes and equipment.

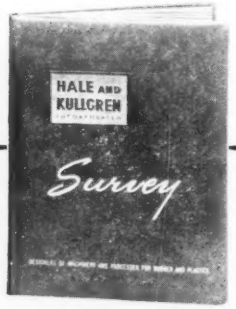
2 **Specific Recommendations** for improving quality, increasing output and reducing costs.

3 **Detailed Estimate** of expenditures.

4 **Layout Drawings** of proposed operation.

5 **Manufacturing Cost Projections** under recommended new plant operation.

HALE and KULLGREN, INC.
613 E. Tallmadge Ave.
Akron, Ohio

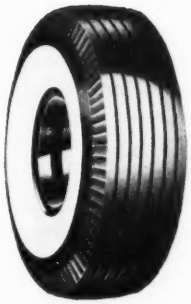


Program for Profits

ANOTHER QUALITY CHEMICAL BY GENERAL TIRE

KO-BLEND I. S.®

. . . eliminates sulfur bloom discoloration in white sidewalls



Ko-Blend I. S. is the best way to protect against costly sulfur bloom in producing premium white sidewall tires. This pre-dispersed insoluble sulfur masterbatch eliminates bloom problems completely and in addition reduces milling time.

For further information write to The General Tire & Rubber Company, Chemical Division, Akron, Ohio, or our

Sales Agents—Harwick Standard Chemical Co., U. S. A.
R. M. Ferguson Co., Canada.
Binney & Smith International Inc., Export.

Creating Progress Through Chemistry

Chemical Division
GENERAL
THE GENERAL TIRE & RUBBER CO.

KO-BLEND I. S.®

General Tire also produces . . .

Vygen* (Polyvinyl Chloride) • Gen-Flo* (Paint Latex) • Gen-Tac* (Vinyl Pyridine Latex)

Kure-Blend MT® (Accelerator Masterbatch)

Glykon* (Polyester Resin) • Polystop® (GRS Shortstop)

*T. M. G. T. & R. Co.

no wrong numbers here . . .

FLEXOL PLASTICIZERS DOP, 426, 810, 10-10, and CC-55

Trade-Mark

Each one has its place in plastics, and each one rates a listing on your books. These phthalates offer excellent heat and light stability, good resistance to water extraction, and excellent electrical properties. In addition, these five FLEXOL Plasticizers allow you to select the phthalate with the proper volatility, solvent power, and dispersing action for your use. Check these phthalates before you consider any other plasticizer for your vinyl plastics or nitrocellulose lacquers.

CARBIDE AND CARBON CHEMICALS

Carbide and Carbon Chemicals Company
A Division of
Union Carbide and Carbon Corporation
30 East 42nd Street UCC New York 17, N. Y.

FLEXOL Plasticizer DOP (di(2-ethylhexyl) phthalate)—the "standard" plasticizer for vinyls for more than ten years.

FLEXOL Plasticizer 426 (a mixed alcohol phthalate) saves you money and offers quality, too.

FLEXOL Plasticizer 810 (a higher alcohol phthalate) is outstanding for its low volatility and the improved low-temperature properties it imparts to vinyls. Plastisols made with 810 have excellent viscosity stability.

FLEXOL Plasticizer 10-10 (didecyl phthalate) is the least volatile of phthalate plasticizers—it has good electrical properties and is a good dispersant, too.

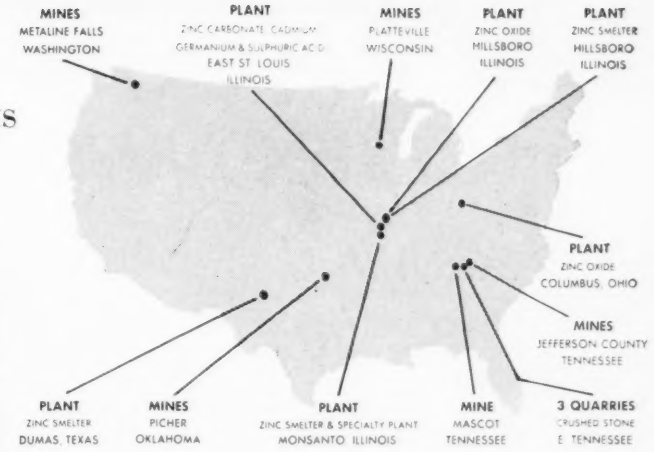
FLEXOL Plasticizer CC-55 (di(2-ethylhexyl) hexahydrophthalate) is an excellent dispersant for vinyl plastisols with stable, low viscosities.

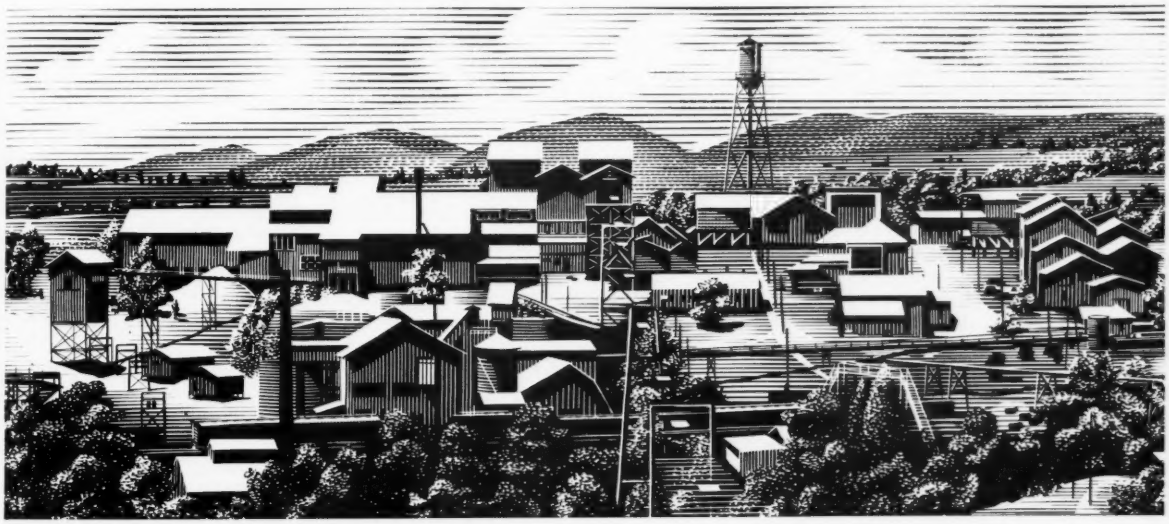
To be sure you have the right phthalate every time, call or write the nearest CARBIDE office. In Canada: Carbide Chemicals Company, Division of Union Carbide Canada Limited, Toronto.

The term "Flexol" is a registered trade-mark of Union Carbide and Carbon Corporation

American Zinc and its products

from A *to* Z





CONCENTRATING MILL,
MASCOT, TENNESSEE

One of the key factors in American Zinc's widespread mining and milling operations. In Tennessee, American Zinc also owns and operates mines in Jefferson County. It is here that one of the largest known reserves of zinc in the United States is found (in excess of 1,250,000 tons of recoverable zinc, proven, with additional large reserves indicated). Other company-owned and operated mining properties are located at Platteville District, Southern Wisconsin; Metaline Falls District, Eastern Washington; and Picher field of the Tri-State Area (Missouri-Kansas-Oklahoma). For the complete picture, see map above.

PRODUCERS OF

ALL GRADES OF SLAB ZINC
ZINC ANODES (Plating & Galvanic)
METALLIC CADMIUM
SULPHURIC ACID
LEAD-FREE and LEADED ZINC OXIDES
ZINC CARBONATE
GERMANIUM DIOXIDE
AGRICULTURAL LIMESTONE
CRUSHED STONE

Distributors for

American Zinc Sales Company

AMERICAN ZINC, LEAD & SMELTING COMPANY

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NEW, LOW-VISCOSITY CHLOROWAX®

speeds vinyl compounding

Now, DIAMOND's new, low-viscosity secondary plasticizer . . . CHLOROWAX LV . . . offers vinyl processors another way to reduce costs and improve quality. CHLOROWAX LV can give you all the advantages of Chlorowax 40, plus additional ease in handling and faster blending.

Viscosity of CHLOROWAX LV falls in the five poise range at 25° C.—a substantial drop from the 20- 40 poise range of normal 40% chlorinated paraffins. Viscosity of CHLOROWAX LV approaches that of commonly employed primary plasticizers. Plant handling is speeded because of greater flow rates.

Better fluidity tends to give flexible plastics better physical characteristics at low temperatures and is an added advantage in plastisol formulations requiring fluidity.

Greater stability of CHLOROWAX LV is important when processing heat is required and results in products with better stability and aging characteristics.

For information or technical co-operation in the use of CHLOROWAX LV or any other CHLOROWAX product (CHLOROWAX 40, 50, 70 and 70-S), write DIAMOND ALKALI COMPANY, Chlorinated Products Division, 300 Union Commerce Building, Cleveland 14, Ohio.

Notice how readily CHLOROWAX LV pours at room temperature. Can this speed handling and blending in your plant?

CHARACTERISTICS OF CHLOROWAX LV

Specific Gravity	1.13
Weight—Pounds Per Gallon	9.4
Viscosity—Poises 25°C.	5.1
Viscosity—S.U.S. 100°F.	902
Viscosity—S.U.S. 210°F.	70
Chlorine—Per cent	40
Solubility in Water	None
Toxicity	Non-Toxic
Odor	None
Flammability	Non-Flammable

DIAMOND CHEMICALS

Diamond Chemicals

DIAMOND CHEMICALS

SALES OFFICES: New York, Philadelphia, Pittsburgh, Cleveland, Cincinnati, Chicago, St. Louis, Memphis, Houston.

DIAMOND DISTRIBUTORS: Dorsett & Jackson, Inc., Los Angeles; Carmona & Hawxhurst, Inc., San Francisco; Van Waters and Rogers, Inc., Seattle and Portland, U. S. A.; Harrisons & Crosfield (Canada) Ltd.

for new equipment, spares or replacements . . .

UNITED *Service-Proved* CRACKER ROLLS

THERE IS A

UNITED®

service-proved

ROLL

FOR EVERY
- **RUBBER**
- **PLASTICS**
- **LINOLEUM**
- **TILE**
- **PAINT**
- **OR OTHER**

NON-METALLIC *PROCESSING REQUIREMENT*

When you specify UNITED ROLLS, your complete satisfaction is guaranteed by over 50 years' experience in the design and manufacture of rolls for practically every type of rolling application. Precision engineered to the specific requirement of the individual machine or equipment in which they are to be used, UNITED *Service-Proved* ROLLS are in use the world over by processors of rubber, plastics, linoleum, paper, paint and scores of other metallic and non-metallic substances.

Specify UNITED ROLLS for new equipment, spares or replacements. The experience and advice of our rolls engineers is available without obligation.

UNITED ENGINEERING AND FOUNDRY COMPANY

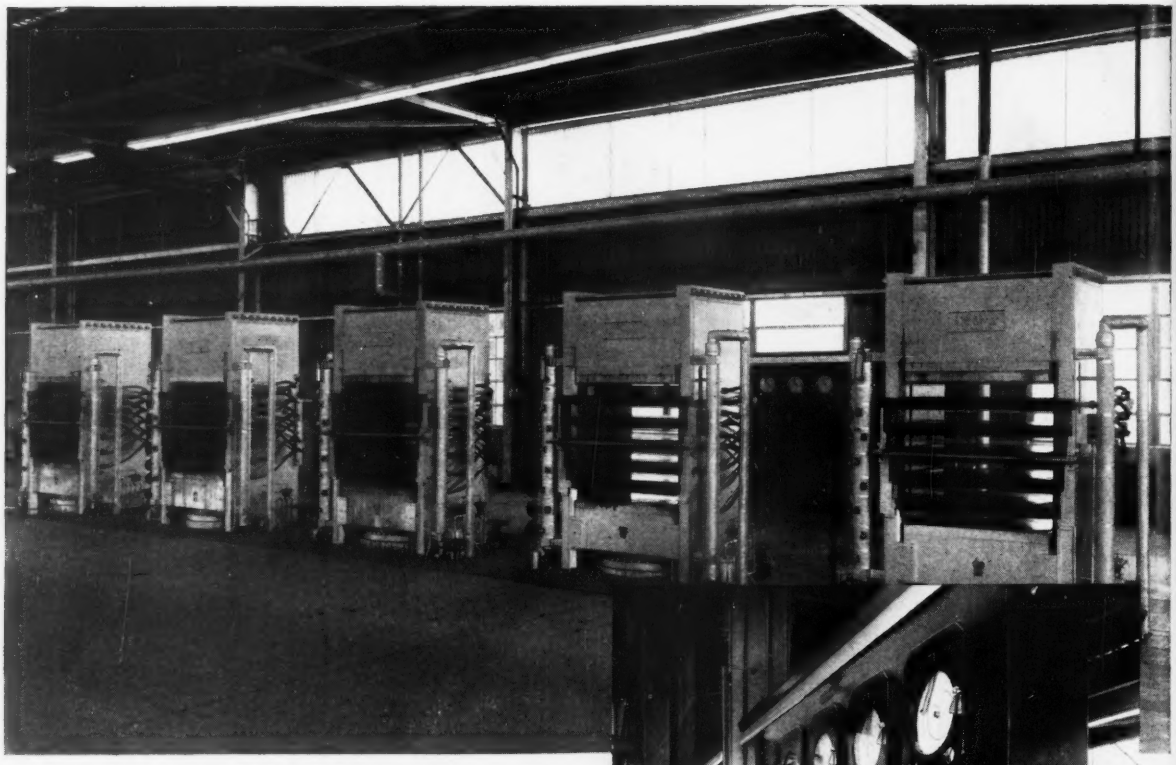
PITTSBURGH, PENNSYLVANIA

Plants at • Pittsburgh • Vandergrift • Youngstown • Canton • Wilmington (Lobdell United Division)

SUBSIDIARIES: Adamson United Company, Akron, Ohio
Stedman Foundry and Machine Company, Inc., Aurora, Indiana

Designers and Builders of Ferrous and Non-Ferrous Rolling Mills, Mill Rolls, Auxiliary Mill and Processing Equipment, Presses and other heavy machinery. Manufacturers of Iron, Nodular Iron and Steel Castings and Weldments.

SOLE CONTROL



International Shoe Company Bryan, Texas, cures sheet stock automatically with Taylor Controls!

TAYLOR controls on their platen presses provide many benefits for the International Shoe Company.

1. **They protect International's fine name by insuring a uniformly high quality in their sheet stock.**
2. **Press performance is 100% predictable.**
3. **Since the entire sequence and duration of the cure is automatically controlled, production schedules can be set up so that the minimum number of operators can be used for the maximum number of presses. Skilled operators are thus released for other duties.**

The larger photograph above illustrates the battery of French Oil Mill Machinery Co. 42″ x 42″ platen presses, with one of the Taylor instrument panels in the background. Inset picture gives a close-up view of the control panel for ten 30″ x 30″ presses. The FULSCOPE* Controllers at top regulate platen temperature, while the FLEX-O-TIMER* Time Cycle Controllers automatically operate the presses, from closing them through bumping, timing the cure, operating the valves in proper sequence and opening of the presses.

*Reg. U.S. Pat. Off.

Note the "off-the-press" location of all instruments on central panels. This gives more convenient access to working areas and enables operators to check performance at a central point. Better "housekeeping" and care of equipment also results.

To find out how you can profitably put Taylor to work in your plant, call your Taylor Field Engineer, or write Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada.

Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY

Gold-plating samples for "3-D" examinations !

Chances are, you'll never order gold-plated pigment, but its use in the Glidden laboratory is important to you. Resinous replicas of test pigment particles are gold-plated to accent the high and low areas. When these replicas are micrographed through an electronic microscope, the 3-dimensional effect indicates the physical structure of the original particle. This electronic-micrograph is then compared with one of a standard particle to check uniformity.

Similar tests for impurities, color, hiding power and other properties are part of the Glidden quality control program which insures your satisfaction with Glidden ZOPAQUE Titanium Dioxides; CADMOLITH Reds and Yellows; SUNOLITH Lithopones. Write for detailed specifications.

THE GLIDDEN COMPANY

Chemicals • Pigments • Metals Division

Baltimore, Maryland • Collinsville, Illinois • Oakland, California • Hammond, Indiana • Scranton, Pa.

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PIGMENTS
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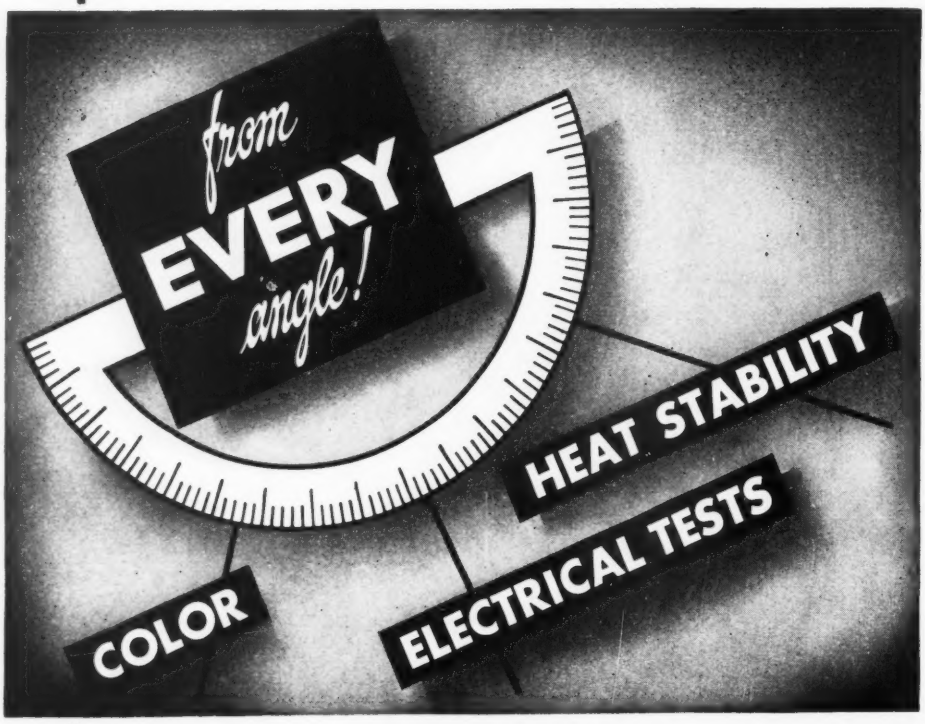
QUALITY
Glidden
PRODUCTS



PIGMENT NO. 33

for Compounding

VINYLS AND SYNTHETIC RUBBER

Sample and technical data sent promptly on request

SOUTHERN CLAYS, Inc.

33 RECTOR STREET
NEW YORK 6, N. Y.

Celanese*
Fortisan*-36 rayon
Solution to many problems in Mechanical Rubber Goods Field

FORTISAN-36, the new Celanese high tenacity, heavy duty saponified acetate rayon offers a filament with:

1. High tensile strength 2. Resistance to stretch
3. Dimensional stability

Some applications where the performance of Fortisan-36 appears to be outstanding are:

IN V-BELTS: Used as a reinforcing member, FORTISAN-36's dimensional stability makes possible matching belts. It does not expand or contract under atmospheric changes or "work" as will belts made with competitive fibers. V-belts made with FORTISAN-36 are now being used in original equipment on automatic washing machines, lawn mowers, trucks, passenger cars and farm tractors. Application on most home appliances requiring V-belts seems logical.

One user of FORTISAN-36 in V-belts reports "It gives considerably better performance than conventional fibers and any change of cord length throughout the belt life is insignificant."

IN AIRCRAFT HYDRAULIC HOSE: FORTISAN-36's high strength means a considerable saving in weight as against other fibers which need extra weight to compensate for lesser strength and higher stretch.

IN FIRE HOSE: Its great strength permits a lighter weight hose with more flexibility. It is also a non-melting fiber. Since it need not be heat stretched it is an economic fiber for this application.

CONVEYOR BELTS, AUTO TRUCK TIRES, PLASTIC LAMINATES, FILTERS, PAPER REINFORCEMENT and many other applications give promise of improved performance when made with FORTISAN-36.

Our technical men have a wealth of data on these applications and many others. May we work with you on the application of FORTISAN-36 to your product problems?

For information on FORTISAN-36 write:
Celanese Corporation of America, Industrial Sales Department, Textile Division, Charlotte, North Carolina. For booklet #TD-200.

Branch offices: 180 Madison Ave., N. Y. 16; Pilgrim Square Building, 9 Overwood Road at West Market St., Akron 13, Ohio.

*Reg. U. S. Pat. Off.

Celanese* Fibers for Industry

FORTISAN* RAYON • FORTISAN*-36 • ARNEL* TRIACETATE • ACETATE • VISCOSE-RAYON

VULCANIZED VEGETABLE OILS

—RUBBER SUBSTITUTES—

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Types, grades and blends for every purpose, wherever Vulcanized Vegetable Oils can be used in production of Rubber Goods—be they Synthetic, Natural, or Reclaimed.

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A LONG ESTABLISHED AND PROVEN PRODUCT

THE CARTER BELL MFG. CO.
SINCE
CARTER BELL PRODUCTS
1903
SPRINGFIELD, NEW JERSEY

Represented by:
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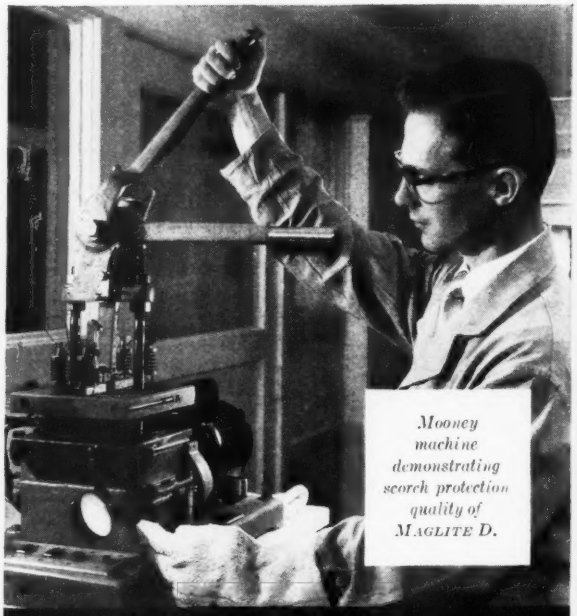
MAGLITE®

The Performance-Proved Brand of Magnesium Oxide



Mooney machine demonstrating scorch protection quality of MAGLITE D.

Ideal for Compounding Neoprene, Hypalon*, Butyl, Nitrile, Natural, and GR-S Rubbers

Uniformity of chemical and physical characteristics, high scorch protection, and ease of dispersion are desirable characteristics you can always count on when you specify the MAGLITE brand These products are available as MAGLITE M, an extra-light magnesium oxide, and MAGLITE D, a dense compound for minimum storage space.

Merck's basic *magnesium carbonate* is another fine product you can depend on. As a filler and reinforcing agent, it provides unexcelled uniformity and quality.

To assist you in overcoming compounding problems, the Marine Magnesium Division maintains a pioneering rubber laboratory devoted to research and technical service on magnesium products.

Stocks are quickly available from 15 warehouses strategically located throughout the country.

Distributors:
G. S. ROBINS & CO. • WHITTAKER, CLARK & DANIELS, INC. • THE C. P. HALL CO.

MERCK & CO., INC.
Marine Magnesium Division

RAHWAY, NEW JERSEY — SOUTH SAN FRANCISCO, CALIFORNIA

Rubber Production Flows Smoothly with...

GLYCERIZED LUBRICANT

(LIQUID CONCENTRATE)

THE ALL PURPOSE EXTERNAL LUBRICANT

NATURAL SYNTHETIC AND RECLAIM STOCKS

DOES NOT INTERFERE WITH TACK OR KNIT

Prevents adhesion of hot rubber slabs when piled . . . banishes dust nuisance by replacing soapstone or talc . . . prevents sticking during cure of extrusions and flat pan coiled tubing . . . excellent release agent for molds, mandrels, air bags, belt drums . . . equally satisfactory for washing and finishing inner tubes; imparts satiny finish . . . greatly aids in the processing of insulated wire and cable. The Production Departments and Laboratories of many rubber manufacturers, through years of using GLYCERIZED, give ample proof of its outstanding qualities as a lubricant for natural, synthetic and reclaimed stocks.

HERE'S WHY

Economical?

HIGHLY CONCENTRATED

1 drum makes up to 50 drums of working solution.

Also Mfgrs. of

RUBBEROL AND SYNTHOL

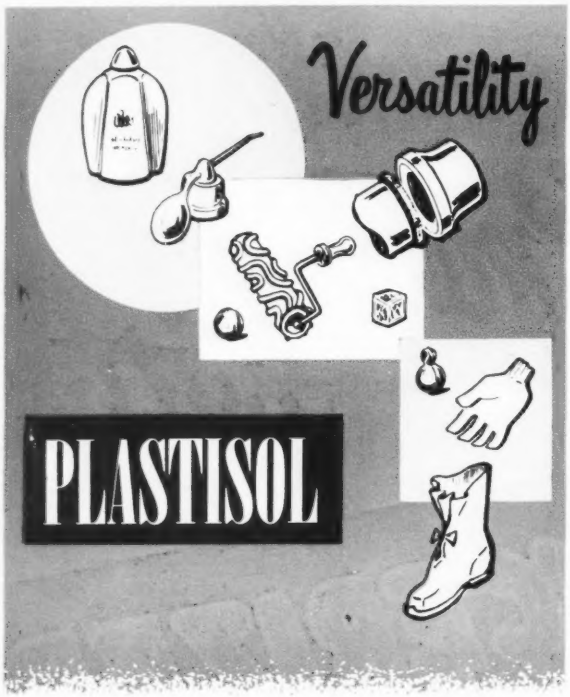
TWO OTHER FACTORY PROVED RUBBER PROCESSING AGENTS

QUALITY SINCE 1884

GENSEKE BROTHERS

RUBBER MATERIALS DIVISION

West 48th Place and Whipple Street — Chicago 32, U.S.A.



The soft, rubber-like characteristics of plastisols lend themselves to many applications:

1. In the creation of a new product.
2. As an improved material for a current product.

The toughness, chemical resistance, wear resistance, tear strength and permanent flexibility make these compounds outstanding as noise deadeners, wire coatings, flexible molded parts, textile coatings, sealing compounds, glove coatings and in many other applications.

If your product requires a soft plastic coating or a molded part, you should consider the use of vinyl plastisols.

"Best Known Name In Plastisol"

Watson-Standard Co.

225 Galveston Ave., Pittsburgh 30, Pa.

NEW YORK OFFICE: 15 Park Row, New York 38, N. Y.
CHICAGO OFFICE: 55 E. Washington Street, Chicago 2, Ill.

PLASTICS • INDUSTRIAL FINISHES • CHEMICALS

The Institution of the Rubber Industry

LONDON

The I.R.I., which was founded in 1921, is now a great association of people engaged in all branches of the Rubber Industry. Its members include rubber producers, manufacturers, scientists, technologists, executives, students and others, in many countries of the world.

It has reached its present position of authority and respect through the high standard it has set for the technical literature it publishes, the diplomas it awards, and the meetings and conferences it organizes.

In collaboration with other Societies, it aims to raise the standing of the Industry throughout the world by improving the technical qualifications of its personnel, extending the study of its raw materials, processes, and products, and by promoting the exchange of technical discovery and information by means of literature, conferences, and meetings.

Membership of the Institution is open to all interested at an annual subscription of $7.50 which entitles the member to receive the bimonthly Transactions free of charge and to purchase other publications (such as the Annual Reports and Monographs) at reduced rates. It also serves to put him in touch with his colleagues and their work in other parts of the world and confers on him full rights to vote, to nomination for election to the Council and to participate in meetings and Conferences organized by the Institution.

Complete details are easily obtained by writing to:

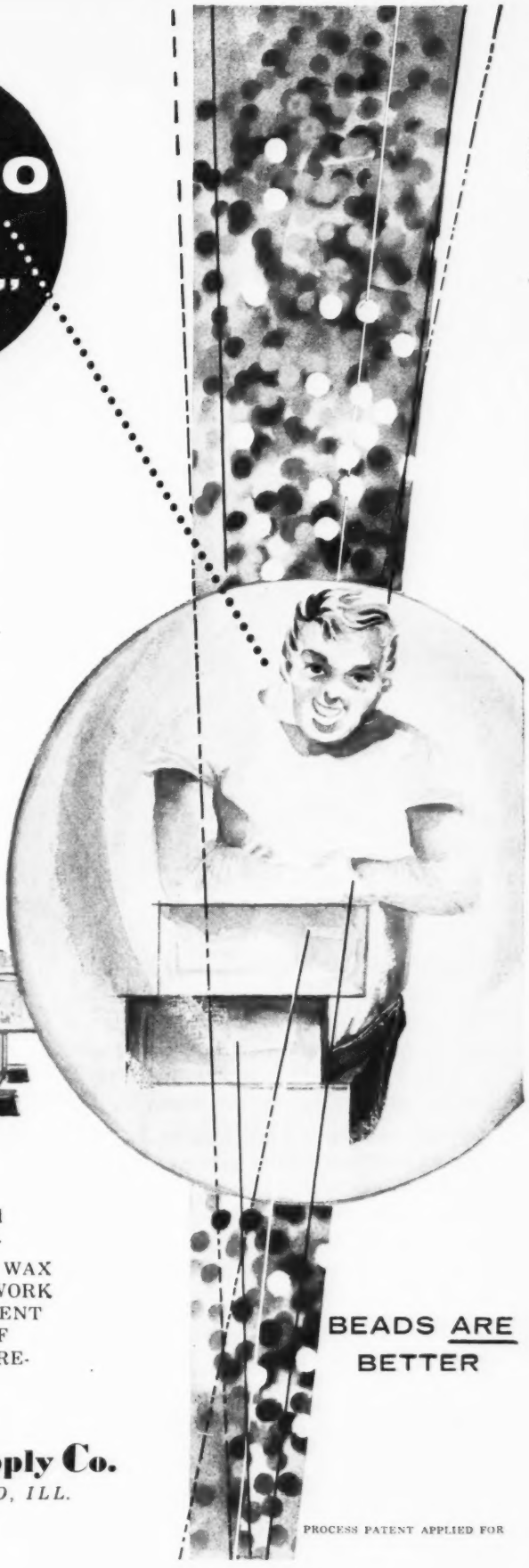
SECRETARY
INSTITUTION OF THE RUBBER INDUSTRY
4, KENSINGTON PLACE GARDENS
LONDON, W. 8, ENGLAND

IT'S A

PLEASURE

TO WORK WITH

DETERO WAX BEADS"



"I like Detero Wax because—

IT POURS easily—no messy flakes—will not stick in hot weather or hot mill rooms. Handles much more easily!

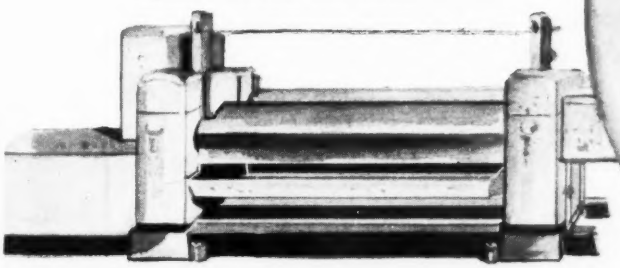
IT MEASURES so easily and quickly—no "approximate" weights!

IT DISPERSES easily and uniformly—cuts mixing time!"

A message to the man who BUYS the wax at your plant:

The man who *uses* DETERO WAX *likes* it because it makes his job easier—*but* DETERO WAX makes the product better, too.

Detero Wax has been tried and tested in rubber formulations, and has been proven to give superior protection against weather and ozone.



Specific wax blends for unusual rubber formulations can be beaded according to your specifications.

Blended DETERO WAX BEADS *speed* and *improve processing* and *improve the product.*

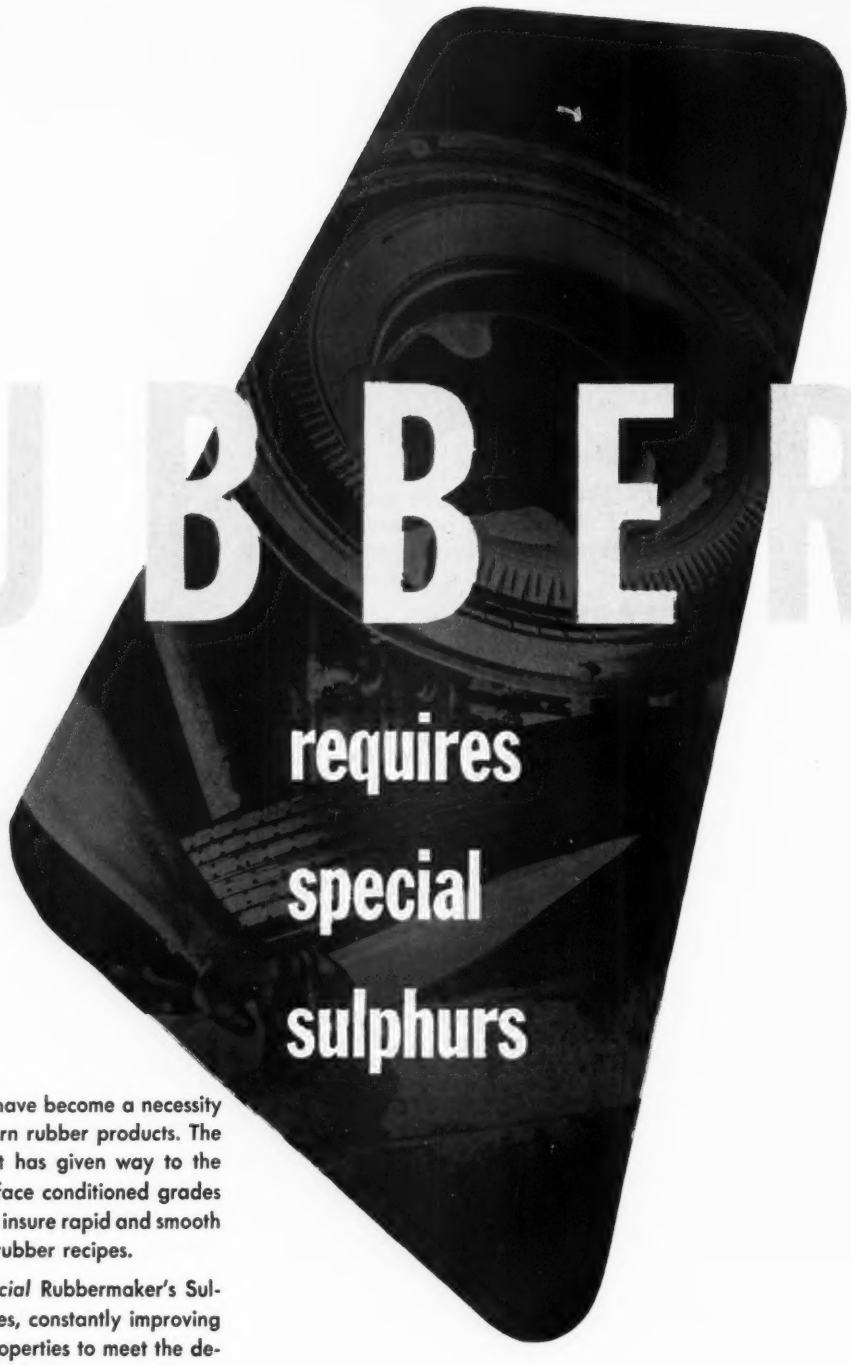
We have also developed special DETERO WAX BEADS for VINYL PLASTICS. LET US WORK WITH YOU—TO *IMPROVE* YOUR PRESENT PRODUCTS or in the DEVELOPMENT OF NEW PRODUCTS FOR SPECIAL REQUIREMENTS OR CONDITIONS.

American Maintenance Supply Co.

236 WEST NORTH AVENUE, CHICAGO, ILL.

BEADS ARE BETTER

PROCESS PATENT APPLIED FOR



Specially treated sulphurs have become a necessity in the formulation of modern rubber products. The "sulphur flour" of the past has given way to the carefully screened and surface conditioned grades of high purity sulphur which insure rapid and smooth blending into a variety of rubber recipes.

Stauffer has offered *special* Rubbermaker's Sulphurs for over three decades, constantly improving the fineness and surface properties to meet the demands of modern rubber technology. In addition, Stauffer has pioneered the commercial production of "insoluble sulphur" to prevent blooming prior to vulcanization.

Plants, offices, and warehouses coast-to-coast assure prompt handling of your requirements.

STAUFFER CHEMICALS FOR RUBBERMAKERS

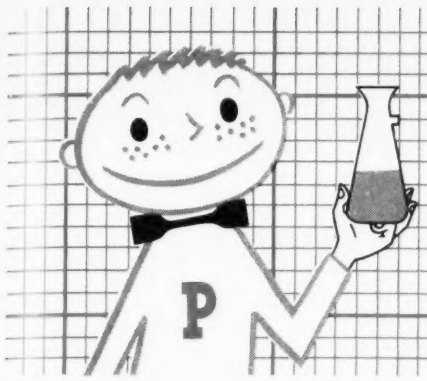
Caustic Soda • Carbon Tetrachloride • Carbon Disulphide
Sulphur Chlorides
SULPHURS—Crystex®—85% "IS" • Tire Brand—99.5% Pure
Tube Brand—Refined • Special Flowers—30% "IS".

Stauffer CHEMICALS SINCE 1885

STAUFFER CHEMICAL COMPANY

380 MADISON AVENUE, NEW YORK 17, N. Y.

221 N. LaSalle St., Chicago 1, Ill. • 636 California St., San Francisco 8, California
326 S. Main Street, Akron 8, Ohio • 824 Wilshire Boulevard, Los Angeles 14, Calif. • 8901 Hempstead Road, Houston 8, Texas • North Portland, Ore. • Weslaco, Texas • Apopka, Fla.



Philprene®

TECHNICAL NEWS

Philprene 1605 For Improved Physical Properties and Processability

Many characteristics must be considered in mechanical goods compounds. Among these are: (1) physical properties, (2) compound cost, (3) rapidity of mixing, (4) extrusion rate, (5) die swell or shrinkage, (6) staining, etc. For many years mechanical goods manufacturers have used GR-S-1104, a hot rubber-Philblack A masterbatch, for its easy processing and good physical properties. This masterbatch contains a slightly staining antioxidant and thus has some limitations.

Compounding Recipe

Masterbatch	**150**
Zinc Oxide	**3**
Stearic Acid	**1**
Sulfur	**1.75**
Santocure	**Variable**
Softener	**5**
Antioxidant	**1**

The current trend is toward improved physical properties in many applications. In several instances, GR-S-1104 cannot quite meet requirements. Since cold rubber possesses better physical properties, a cold rubber-Philblack A masterbatch . . . called PHILPRENE 1605 . . . has been prepared. PHILPRENE 1605 contains a non-staining antioxidant to qualify it for a greater number of applications.

Laboratory and plant information show that PHILPRENE 1605 possesses better stress-strain properties and improved extrusion performance. Manufacturers report the following advantages of PHILPRENE 1605 compared to GR-S-1104:

1. **Better physical properties**
2. **Reduced compound cost**
3. **Mixing time 10 per cent shorter**
4. **Less die swell**

Complete Technical Service

Call on us for full information on the applications PHILPRENE has in your operations. No obligation. We're glad to help. The full resources of our Sales-Service Laboratory are at your service through our Technical Representatives.

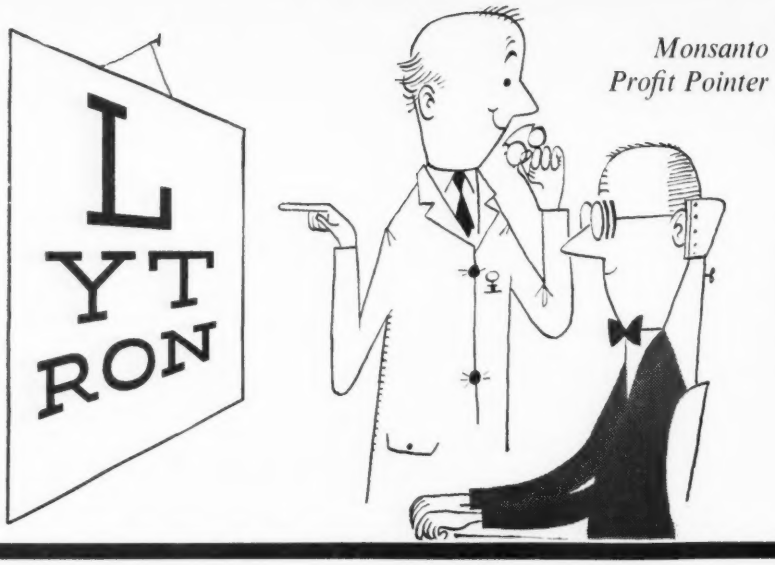
The laboratory data below demonstrates the superiority of Philprene 1605:

Cure: 30 minutes at 307°F							Garvey Die Extrusion at 250°F		3/16" Round Die Extrusion at 125°F	
Master-batch	PHR Santocure	Com-pression Set %	300% Modulus psi	Tensile psi	Elongation %	Shore Hardness	Inches per minute	Grams per minute	Grams per meter	Shrinkage %
PHILPRENE 1605	1.0	16.7	1760	2880	525	61	35.8	70.8	37.05	45.5
PHILPRENE 1605	1.25	12.8	1900	2830	475	63	35.2	71.5	37.30	45.8
GR-S-1104	1.3	17.6	1800	2500	420	57	30.8	70.2	45.15	55.1

PHILLIPS CHEMICAL COMPANY

Rubber Chemicals Division

318 Water Street, Akron 8, Ohio



Look at Lytron*

*LYTRON REG. U.S. PAT. OFF.

Monsanto supplies a Lytron thickener for every latex or aqueous system!

No other manufacturer offers such a broad and versatile line of thickening agents. Monsanto's Lytrons are 100% synthetic polyelectrolytes. All contribute extremely high viscosity. Lower your costs by obtaining maximum thickening efficiency with minimum amount of Lytron. Supplied in both solid and liquid form. For technical bulletins and free experimental samples, write on your letterhead to Monsanto Chemical Company, Plastics Division, Dept. RW-10, Springfield 2, Massachusetts.

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THE STAMFORD RUBBER SUPPLY CO
Vulcanized Oil

THE STAMFORD RUBBER SUPPLY CO

"FACTICE"®
A *Complete* LINE OF
WHITE
BROWN
and AMBER
GRADES

OLDEST AND LARGEST MANUFACTURERS OF "FACTICE" BRAND VULCANIZED OIL SINCE 1900

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For
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DEPENDABILITY

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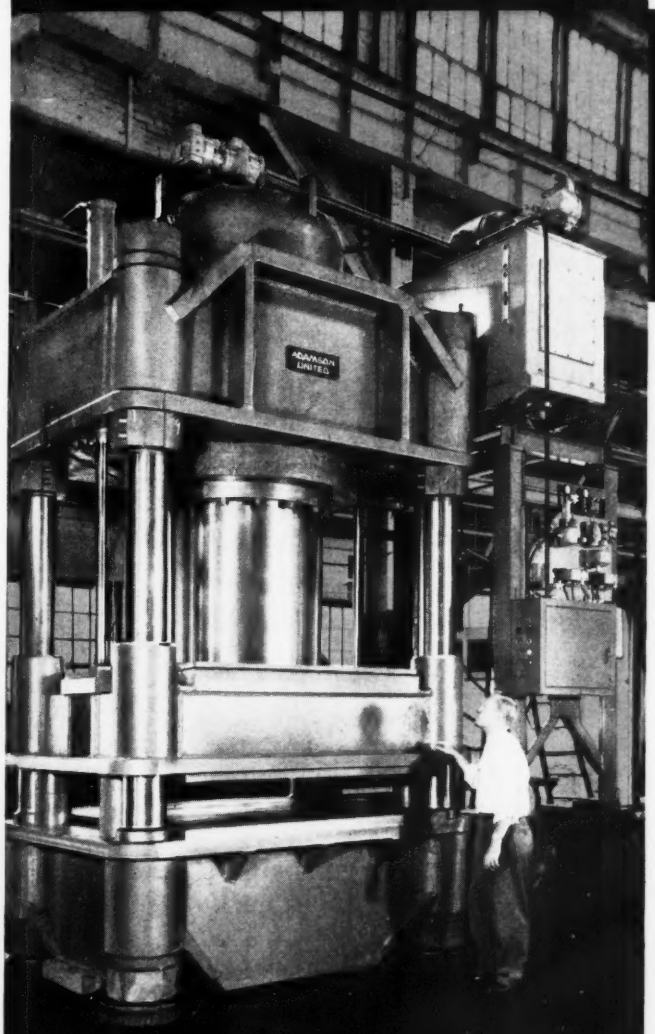

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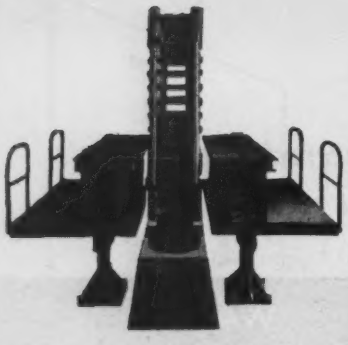

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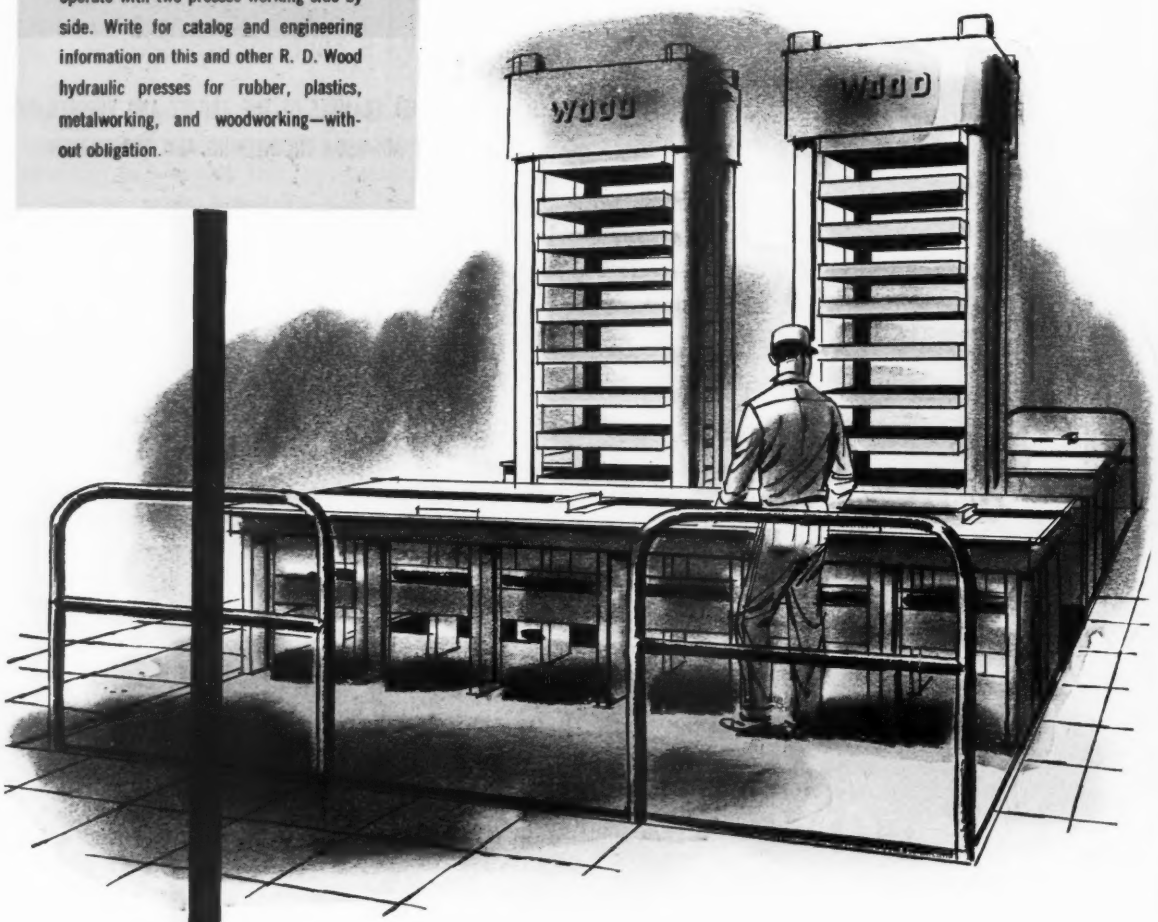

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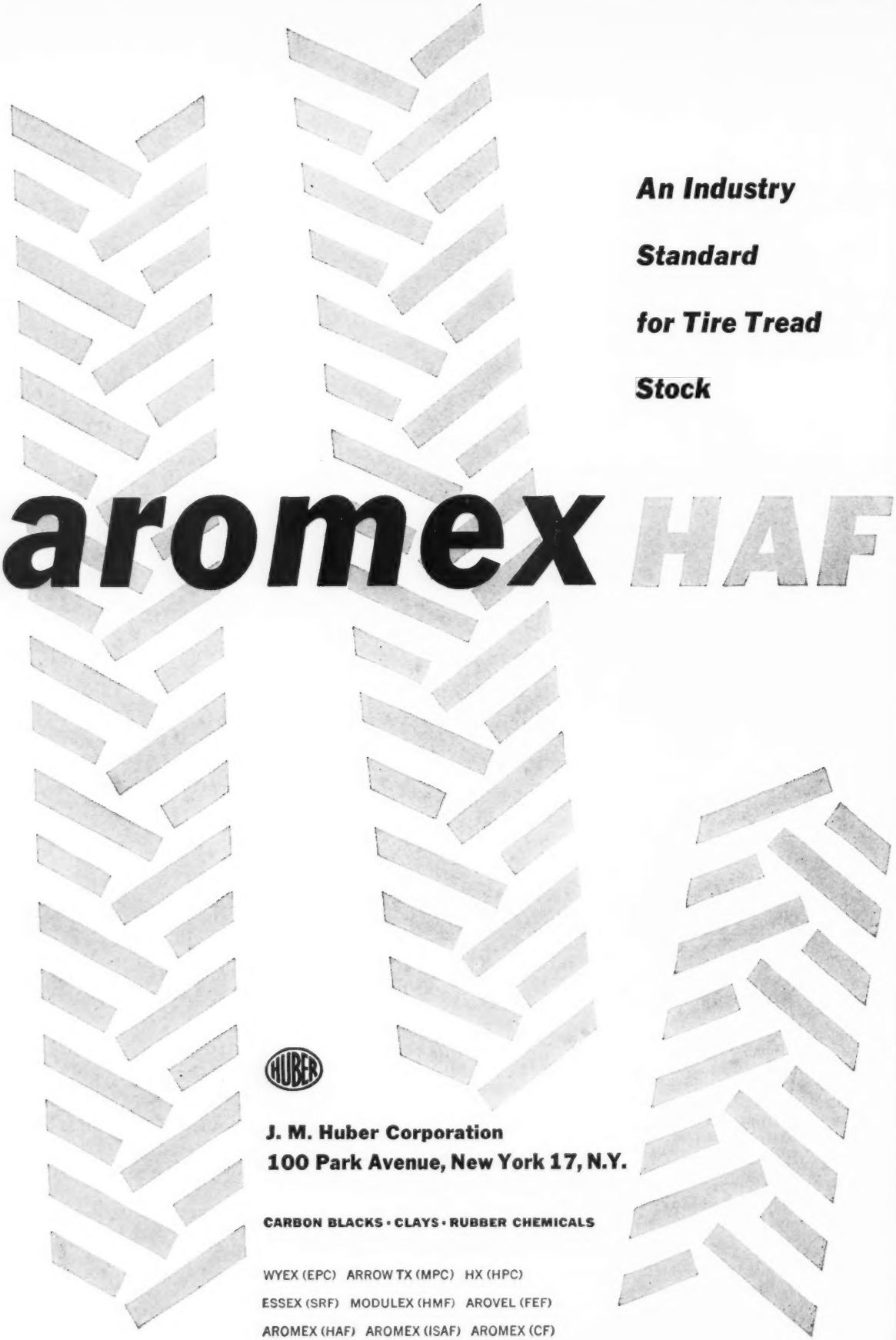
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RUBBER WORLD
OCTOBER, 1955

R. L. Zapp

Abrasion of Butyl Rubber[1]

By R. L. ZAPP

Esso Laboratories, Standard Oil Development Co., *Linden, N. J.*

By use of the Lambourn abrader and a further development from the work of Schallamach on abrasion a new concept is proposed which states that what is needed for best abrasion resistance is a soft, yet tough material.

Butyl rubber owes its comparable or superior abrasion resistance (when compared to other rubbers) to the fact that its vulcanizates are dynamically softer. Polymer and compounding variables that tend to *decrease* the ratio of dynamic hardness over rupture energy will improve abrasion resistance and result in distinctly superior tire treads.

IN RELATION to the vast quantity of literature on the physical properties of rubber-like materials, the amount of published work on the abrasion of rubber is quite small. This situation is surprising in view of the fact that abrasion resistance is of prime importance to the large volume use of rubber. Perhaps it is because so much of the work in this field has been directed toward the prediction of service wear rather than an understanding of the factors involved in the abrasion of highly elastic materials. The consensus of most of the work in abrasion has been that laboratory tests at best are only a rough indication of how a rubber vulcanizate will perform in service. Service wear tests provided the final answer.

It is possible that too much was expected of laboratory abrasion tests before rubber abrasion was understood. It was felt at the inception of this present study with Butyl rubber that a further understanding of the factors involved in abrasion would eventually aid in obtaining better road wear correlation. Thus the two purposes of understanding abrasion and predicting service wear would be welded into a single objective. A better understanding of abrasion could also aid the development of a tire from a new polymer such as Butyl. It would direct the molecular and compounding changes necessary for improved wear resistance.

The Lambourn Abrader

To start our study of abrasion the Lambourn abrader was selected as the laboratory instrument. Developed at Dunlop Tire & Rubber Co. in England, it has not been widely used in this country. Two recent articles[2] are among the few publications of abrasion studies made with this machine.

This type of abrader was selected because variations in velocity of slip and braking force can be made. An indication of braking force is important. It was pointed out more than 25 years ago by Williams[3] that work done on the sample should be related to volume loss of rubber. This relation, of course, would be valid at a given velocity of slip.

Description of the Abrader

The Lambourn abrader simulates the rolling deformation of a rear wheel under load. In this case a small disk of rubber is driven against an abrasive wheel. A

[1] Presented before the Akron Polymer Lecture Group, Akron, O., Nov. 5, 1954, and before the Division of Rubber Chemistry, ACS, Detroit, Mich., May 4, 1955. This paper is Contribution No. 1, Chemical Research Division, Esso Research & Engineering Co., Linden, N. J.

[2] J. W. Adams *et al.*, *Rubber Chem Tech.*, 25, 191 (1952). E. F. Powell, S. W. Gough, RUBBER WORLD, 132, 201 (1955).

[3] *Ind. Eng. Chem.*, 19, 674 (1927).

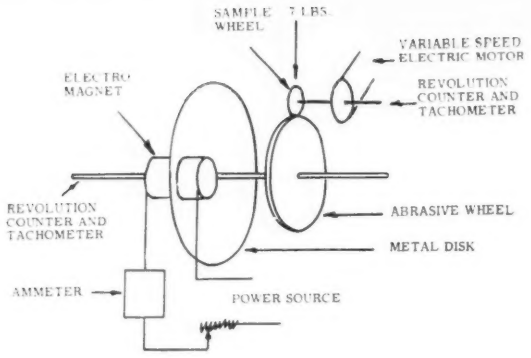


Fig. 1. Schematic drawing of Lambourn abrader

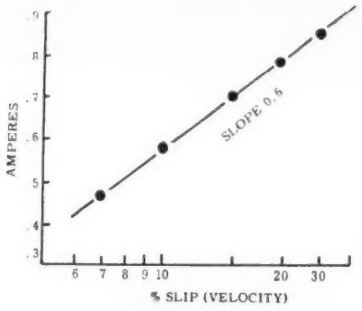


Fig. 3. Amperes *versus* + slip may also be termed fiction *versus* velocity of slippage

variable-speed electric motor drives the sample wheel at a prescribed rpm, and it in turn rotates the abrasive wheel. Attached to the shaft of the abrasive wheel is a metal disk which operates in a variable magnetic field and thus supplies a variable degree of resistance to rotation. This varying degree of resistance will cause a change in the degree or velocity of slip between the sample wheel and the abrasive wheel.

A schematic sketch in Figure 1 shows the rudiments of the machine. The degree of slip is positively determined by two revolution counters attached to the sample wheel and the abrasive wheel shafts. The tachometers serve as a guide so that slip may be controlled during the course of the experiment. With the rubber disk rotating at a prescribed 600 rpm. various abrasive wheel speeds can be controlled by the current to the magnetic brake, producing the different degrees of slip. Slip can be varied from 5% to about a maximum of 40%, depending upon the amount of electrical current supplied to the coils of the brake. The variations in current requirement are recorded on a chart so that an average for the entire run can be calculated. Since the apparatus is supplied with a constant D.C. voltage, amperage measurements are directly related to power or electrical energy supplied to the brake.

Based upon the relative dimensions of a sample wheel and a regular tire tread, a seven-pound load on the sample would produce about the same unit area load as that borne by a commercial tire. A standard-size tire and wheel revolve in the neighborhood of 600 rpm. at 60 miles per hour. Although these conditions have been varied during the laboratory study of abrasion, a 600-rpm. sample speed and seven-pound load have been designated as standard.

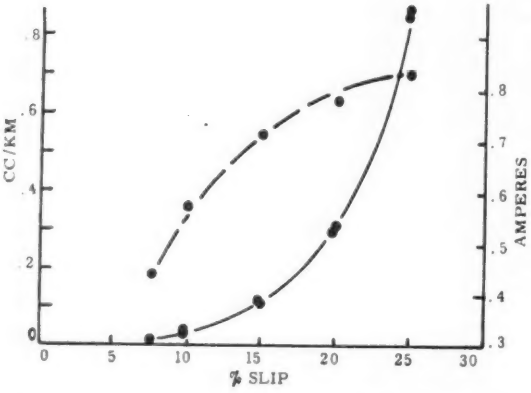


Fig. 2. Abrasion loss and amperes of the brake *versus* % slip. Solid line, cc./km. Dotted line, amperes

Type of Data Obtained

Under the standard conditions of wheel load and sample speed, variations in the amount of slip are obtained by changing the electric current of the magnetic brake. The effect of this change on the abrasion of a Butyl-channel black tread is shown in Figure 2. Plotted on rectangular coordinates, one curve (solid line) relates the degree of slip to the abrasion loss, and the other curve (broken line) shows the braking force, in terms of amperes to the brake, required for a given degree of slip.

Figure 2 graphically shows how sensitive is abrasion loss to the degree of slip, and thus it is not surprising how conditions of driving will greatly alter tire life on the road. The curve appears exponential in character. The reading of current to the magnetic brake, at constant D.C. voltage, will be that fraction of the original energy input at the motor after mechanical friction and heat build-up in the rubber have been subtracted. As such, then, it will be a measure of the resistance to slippage between the abrasive wheel and the rubber surface. This resistance is made up of interfacial tension and the energy of abrasion. Since sliding friction is always accompanied by some degree of abrasion,[4] the resistance, in this instance, will be considered frictional under severe conditions of abrasion.

Support for this combination of factors, as applied to rubber abrasion, is found in the classical observations on sliding friction.[5] These experiments have shown that the sliding friction between two surfaces is related to the logarithm of the velocity of slip. Since the sample wheel is running at constant speed, an increase in the % slip is the same as an increase in the velocity of slip. On this basis, then, a measure of the electrical current requirements for a given degree of slip is an indication of friction, as shown in Figure 3.

[4] "The Friction and Lubrication of Solids," pp. 73-89, F. P. Bowden, D. Tabor. Oxford University Press, Amen House, London E.C.4, England (1950).
[5] C. A. Maney, *Am. J. Phys.*, 20, 203 (1952).

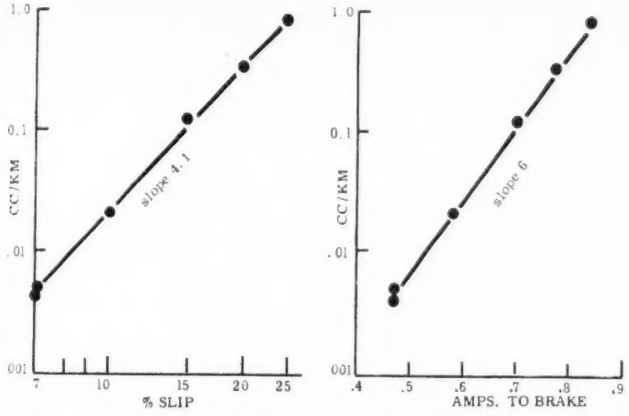


Fig. 4. Relation of abrasion loss to slip and braking force

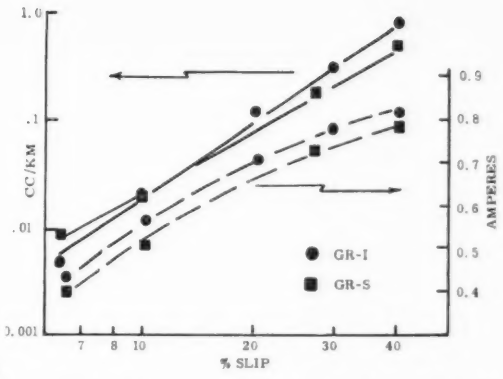


Fig. 5. Slip *versus* abrasion loss for GR-S type and GR-I (now Enjay Butyl) treads

The exponential character of the relation of degree of slip and abrasion loss is displayed also in Figure 4 where the variables form a linear plot on logarithmic coordinates. The slope of the line is approximately four; in fact, a large number of plots during the course of this study yielded slopes between about 3.7 and 4.3. It has therefore been stated in a generalized form that the abrasion loss is related to the fourth power of the degree of slip. Abrasion experiments conducted at a given slip, wherein small experimental variations occur, have been corrected to the exact degree of slip on this basis.

A cross plot of the data of Figure 2 relates abrasion loss as a function of the electrical current to the brake. The points are best fitted by a semi-logarithmic plot. Why abrasion loss should increase so drastically with either degree of slip or electrical current to the brake is unexplained at this time. One could postulate on the basis of rate of energy input that abrasion loss should be directly related to velocity of slippage. Although insufficient data are available, the effect might be attributed to a surface temperature increase as velocity of slip is increased. Thus abrasion loss would appear as an accelerating function of degree of slip.

The Abrasion of GR-S and Butyl Tread Compounds

When abrasion experiments were first conducted with different types of rubbers, relations between degree of slip and abrasion loss were frequently not the same. In Figure 5 the behaviors of a Butyl tread and a GR-S tread are shown. Each tread contains 50 parts, per 100 of rubber, of an MPC channel black. The GR-S compound is vulcanized with 1.7 parts of sulfur and one part of Santocure[6] in a conventional formulation. The striking feature of this logarithmic plot is the crossing of the lines. For these two compounds this figure indicates that the Butyl tread is superior at lower degrees of slip, and the GR-S tread at higher degrees of slip. Such a behavior could be explained on the grounds that Butyl has a slower relaxation time than GR-S and consequently does not adjust to higher velocities of deformation as well as GR-S. Thus at a slower degree or velocity of slip the Butyl molecules have more time to orient under surface deformation and thus present a greater resistance to rupture.

An important part of this abrasion analysis is the lower curves relating degree of slip to electrical input to the magnetic brake. The relative position of the two curves indicates that to obtain a given slip more braking force must be supplied to the Butyl compound. If abrasion loss is then based on the loss per kilometer per ampere to the brake, the plot of abrasion *loss* versus slip would be lowered for Butyl in relation to the GR-S tread. Further, if abrasion loss is determined as a function of electrical energy to the brake (regardless of the degree of slip), Butyl would be everywhere superior to the GR-S.

Figure 6 presents this fact pictorially at a constant current input of 0.76-ampere. The wheel on the right, a Butyl tread, is smoother, has operated at less slip, and

Fig. 6. Abrasion of GR-S type and GR-I (now Enjay Butyl) at constant electrical current to the Lambourn abrader magnetic brake. Left: standard GR-S (MPC black), 0.76-amp. to brake, 23.8% slip, 0.67-gm. loss/km. Right: GR-I-18 (MPC black), 0.76-amp. to brake, 19.3% slip, 0.28-gm. loss/km.

[6] Mercapto-benzothiazyl-mono-cyclohexyl-sulfenamide (Monsanto Chemical Co.).

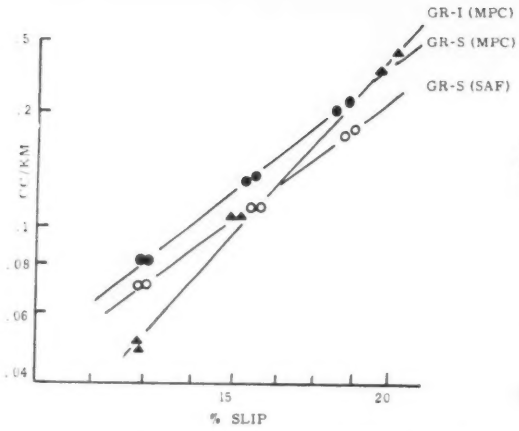


Fig. 7. Abrasion of GR-S type and GR-I (now Enjay Butyl) tread compounds at varying % slip on Lambourn abrader

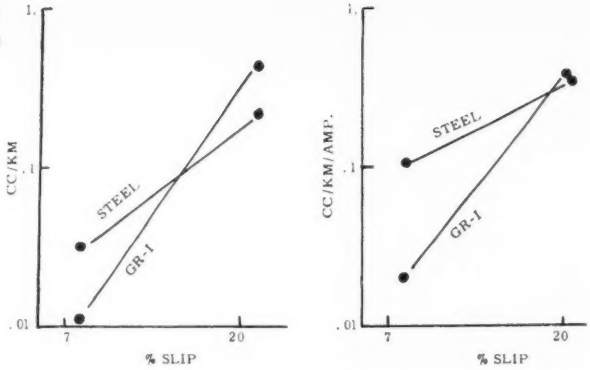


Fig. 8. Abrasion of GR-I (now Enjay Butyl) compared to steel on Lambourn abrader

has shown far less abrasive wear under these conditions than the GR-S. At a constant slip of 19.3%, however, where the amperage to the brake is different, the GR-S compound is slightly superior to this Butyl tread. It has been suggested that this somewhat greater friction for Butyl treads is responsible for the quieter running quality of Butyl experimental tires.

This observation embracing the change of relative abrasion resistance with degree of slip has been observed in later studies. Figure 7 shows two cold rubber GR-S treads—one with a fine SAF carbon, compared to a well-prepared Butyl-channel black tread. Again the line defining the function of slip and abrasion loss crosses the lines for the two GR-S treads. An analogous observation, which presents two greatly different relative behaviors, can be made between the abrasion of rubber and a metal.

Abrasion of Steel and Rubber

An interesting example of abrasion differences of materials is given by such two extremes as rubber and steel. A steel wheel the same size as the rubber wheels was run on the Lambourn abrader and compared to a GR-I-17 (Enjay Butyl 217) tread compound. The data are present in Table 1.

TABLE 1

	Braking		Abrasion Loss		
Material	Force, Amps	% Slip	Gms/Km	Cc/Km	Cc/Km/Amp
Steel	0.56	20.5	1.51	0.19	0.34
GR-I tread*	0.84	20.1	0.35	0.32	0.38
Steel	0.27	7.7	0.23	0.03	0.11
GR-I tread*	0.50	7.8	0.011	0.01	0.02

* Enjay Butyl.

Referring to the volume loss per kilometer, the steel wheel has about *one-half* the loss of the rubber at 20% slip, but three times the loss at 7% slip. In a graph the trend would appear as shown on the left in Figure 8. At high % slip steel is superior to rubber; at low % slip the reverse is true. In addition, the traction or coefficient of friction of rubber against abrasives is greater. Observing the electrical braking forces in the table, it is evident how much more current is required to obtain a given degree of slip for rubber as compared to steel. When braking force is taken into consideration, as shown on the right side of Figure 8, the cross-over point advances to high degrees of slip. Here abrasion loss per kilometer is adjusted to the same braking energy input, and the rubber tread appears to be even more superior to steel at low degrees or velocities of slip.

These facts illustrate why rubber has often been characterized as more resistant to abrasion than steel. For applications such as conveyor belts, coal chutes, etc., this superior abrasion resistance of rubber has been found through experience to be the case. However, if one were to grind a piece of rubber against an abrasive as an axe is ground, the reverse would surely be true. This latter condition is one of 100% slip where steel is much superior to rubber. Because of the greater frictional surface of rubber belts and chutes, coal, ore, or rock particles roll and tumble along the rubber surface aided by the high elastic nature of the rubber. This would be a condition of *low slip* where rubber is superior. On the other hand, rocks, ore, or coal on a metal chute would slide and scrape instead of rolling or tumbling, a condition of high slip resulting in higher abrasion loss, even for steel, since the absolute trend of abrasion increases with increasing velocity of slip for all materials.

Precision of the Measurements

A discussion of the Lambourn abrader would not be complete unless some reference was made to the precision of the abrasion measurements. In general, repetitive runs, after corrections for degree of slip and braking force are made, showed a coefficient of variation of only 4.5%. To illustrate this degree of precision a sample table of six runs on the sample Butyl compound is given in Table 2.

Columns 2, 3, and 4 represent the recorded data. As corrections are made to the exact degree of slip in column 5, the standard deviation is reduced. The further refinement of column 6 adjusts the values for variations in frictional factors with a further decrease in the standard deviation and coefficient of variation as a consequence.

Fig. 9. Sample wheel with four circumferential ribs for Lambourn abrader

TABLE 2. PRECISION OF ABRASION MEASUREMENTS

Butyl Rubber Channel Black Tread Compound	Amps.	% Slip	Cc/Km	Cc/Km Cor. to 19% Slip	Cc/Km/Amp. 19% Slip
A	0.71	19.1	0.219	0.215	0.302
B	0.70	19.0	0.201	0.201	0.288
C	0.67	18.8	0.168	0.175	0.264
D	0.71	19.2	0.212	0.203	0.288
E	0.69	19.0	0.192	0.192	0.278
F	0.71	18.9	0.206	0.210	0.296
	Mean		0.200	0.199	0.286
	Std. Dev.		0.018	0.014	0.013
	Coefficient of variation		9.0	7.0	4.5

Conditions of Abrasion

Before a more penetrating study of abrasion could be conducted a certain amount of orientation as to proper conditions of abrasion was deemed necessary. During this orientation phase of the study a definite anomaly was brought out between laboratory test and road wear test. In the laboratory tests with smooth surfaced wheels, a harder vulcanized compound made from a higher carbon black loading appeared slightly superior to one with lower loading of carbon black.

In controlled road tests on Butyl treads the opposite was observed; in road tests the softer, lower loadings of carbon black were superior. Conditions of abrasion were undoubtedly different, but the tread surfaces were also different. The actual tire had a tread pattern, and the sample wheel a smooth surface. When studies were made with a sample tread pattern on the sample wheel, unexpected observations were made.

Effect of a Tread Pattern

A tread pattern introduces mechanical softness to the rubber surface. Each rib or other incremental surface shape may move independently of areas adjacent to it during the time the surface is in contact with the road.

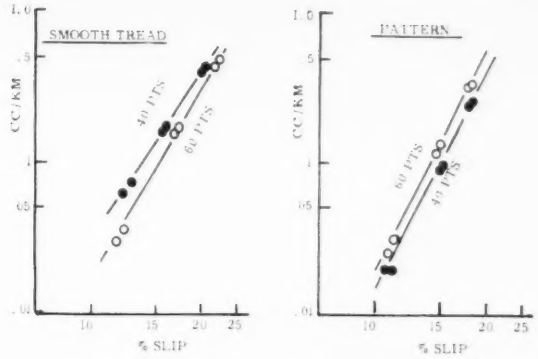


Fig. 10. Effect of tread pattern on abrasion of Butyl compound with two different carbon black loadings

It is conceivable, therefore, that different slip conditions could exist and relative abrasive wear be altered.

To make observations of the effect of a tread pattern as laboratory abrasion, a sample wheel was molded with four circumferential ribs. This is shown in Figure 9. The dimensions of the wheel are 1⅝ inches in diameter, ⅜-inch thick, and the cross-section of the ribs are $^{3}/_{64}$- by $^{1}/_{16}$-inch deep.

In Figure 10, abrasion losses are compared with a smooth wheel surface and a tread pattern using a compound possessing 60 parts of channel black and one containing 40 parts. These abrasion losses in cc per kilometer are compared as a function of slip for smooth treads on the left and for tread patterns on the right. The reversal of the relative positions is apparent at once. In common with road wear results laboratory abrasion losses are lower with the softer material when a tread pattern is used. A 50-part channel black compound would appear in an intermediate position. Braking force requirements are greater for the harder material in both cases, but this condition does not affect their relative positions.

Even stranger than this reversal of positions is the comparison of the absolute abrasion loss when a tread pattern and smooth surface are compared with the same compound. Such a comparison is made in Figure 11. This figure plots absolute volume loss as a function of slip. The tread pattern displays lower loss at all points in spite of the fact that actually less rubber is in contact with abrasive surface. Although not shown graphically, with very hard compounds of more than 60 parts of channel black the advantage of the tread pattern disappears. It has been stated in a tire design publication[7] that a tread pattern is only used to obtain nonskid qualities especially in wet weather. A tread pattern on an actual tire has been considered to be actually inferior to a smooth tire on the basis of road wear. These laboratory tests predict the opposite trend.

Effect of Wheel Load

It was indicated earlier in the discussion that a sample wheel load of seven pounds was equivalent to the unit area load of a regular tire tread. In a study of

[7] "Pneumatic Tire Design, p. 12. E. C. Woods, IRI Monograph. W. Heffer & Sons, Ltd., Cambridge, England. (1952).

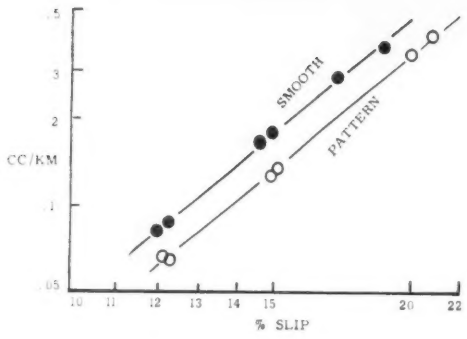


Fig. 11. Comparison of tread pattern *versus* smooth surface for the same Butyl tread compound

the effect of wheel load on abrasion a relation other than linear was observed. In these experiments observations were made with three Butyl treads of varying hardness. These were made from a 60, 50, and 40 parts of MPC channel black per 100 parts of Butyl.

Figure 12 gives the results of that study in two graphs. The lower portion presents abrasion loss at one degree of slip as a function of wheel load. In common with the results discussed on the effect of tread pattern, the softer tread made with 40 parts of carbon appears to an advantage at all wheel loads. An abrupt increase is noted above seven pounds, giving the curves an S shaped appearance. This irregularity appears in face of the essentially linear nature of the frictional curves in the upper portion. Here braking force requirements rise regularly with wheel load, and at all loads the harder compound requires more electrical energy.

A combination of these two plots, wherein braking force is accounted for in the overall abrasion losses, brings out two interesting points, as shown in Figure 13. When abrasion loss is determined as volume loss per kilometer per ampere to the brake, the S shape of the curves becomes more pronounced. At the lower end of the load scale, the loss so calculated turns upward. In a practical sense this result can be interpreted as follows. If the load on a wheel is decreased while the same braking force is maintained, abrasion losses will increase because slippage will occur more readily. At the higher end of the wheel load scale, the convergence of the curves for the various compound hardnesses is more apparent. Thus if road tests are conducted under conditions of extreme overload, differences in mileage life or abrasion loss would tend to be made obscure.

Abrasion and Ambient Temperature

The effects of climatic temperatures have often been cited as reasons for changes in relative tire wear performance. Laboratory abrasion tests support this possibility. The Lambourn abrader had originally been equipped with a transparent plastic case which had a wide slot to accommodate the abrasive wheel. Light flexible air hose was connected to the plastic case so that air at controlled temperature could be circulated around the sample wheel. The temperature range of −20 to +50° C could be obtained.

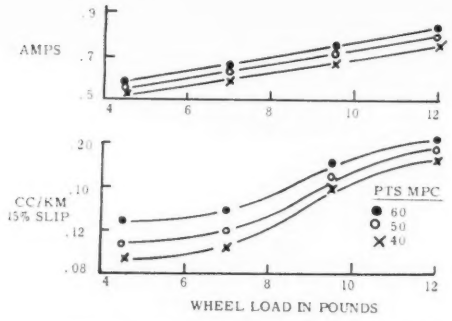


Fig. 12. Effect of variations in wheel load on abrasion loss and braking force

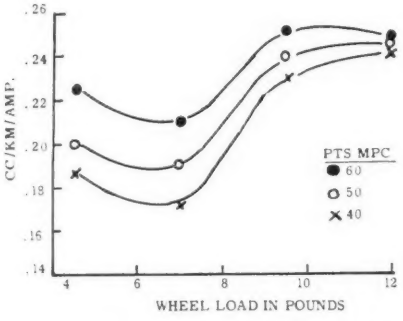


Fig. 13. Effect of variations in wheel load on abrasion in cc/km/amp..

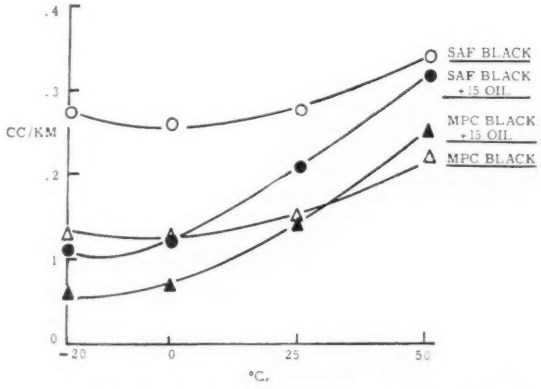


Fig. 14. Relation between temperature and abrasion loss for Butyl treads

In Figure 14 the results of this experiment are presented for four different Butyl tread compounds. Curves 1 and 2 represent 50 parts of MPC channel black. No. 1 has no hydrocarbon oil plasticizer, and No. 2 has 15 parts per 100 of polymer. Curves 3 and 4 are furnace black counter-parts. No. 1 has 50 parts of an SAF carbon and no oil plasticizer; while No. 2 has 15 parts of a hydrocarbon oil. It is strikingly evident that the presence of oil makes the abrasion resistance of the tread compound more sensitive to the surrounding temperature. This point is apparent with either MPC or SAF carbon regardless of the absolute position of the curves.

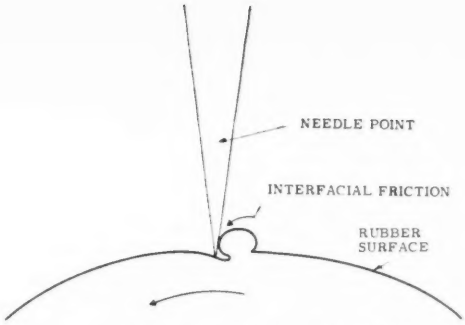


Fig. 15. Schematic sketch of Shallamach needle abrader

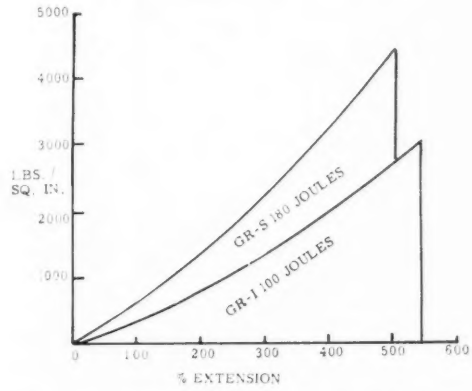


Fig. 16. Rupture energy of typical GR-S (cold or LTP type) and GR-I (now Enjay Butyl) treads

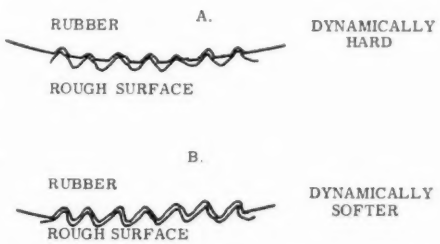


Fig. 17. Extension of Schallamach concept to rough surface

In the case of the channel black the oil-extended tread appears poorer at high temperatures and superior at lower temperatures when compared to the tread with no plasticizer. As will be discussed later, this effect is quite probably dependent upon the change of elastic qualities in combination with rupture strengths of the different compounds. Such a combination of factors could also explain the fact that the curves tend to rise as ambient temperature descends below freezing. In much the same manner, but to a much smaller extent, the abrasion of GR-S and natural rubber treads appears to be somewhat less sensitive to ambient temperature than comparable Butyl compounds.

[8] *J. Polymer Sci.*, 9, 385 (1952).

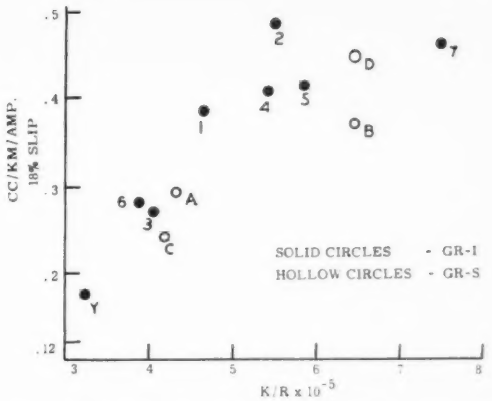


Fig. 18. Relation between abrasion loss in cc/km/amp. and K/R for seven Butyl tire tread compounds and four LTP GR-S type of tread compounds. Y represents special Butyl tread with optimum properties

Concept of the Abrasion of Rubber

A new approach to the subject of abrasion was introduced by Schallamach[8] when he studied the abrasion of rubber by a needle. The needle was attached to a ring dynamometer which measured the thrust required to embed the needle in a revolving cylinder of rubber. The deflection of the needle indicated the tractive force or friction. Figure 15 gives a schematic sketch of the needle and the revolving rubber surface with the gouged portion of rubber ahead of the point of contact.

In the study of the needle abrasion of gum vulcanizates of natural rubber it was observed that the tractive force decreased slightly with increasing state of cure or cross-linking, while the amount of rubber ripped off increased markedly. It would appear from these observations that the rupture strength of the rubber was decreasing rapidly with overvulcanization, as would be expected. With compounds containing carbon black, tractive forces increased, but the higher modulus of the material produced gouged patterns of higher frequency. The increased rupture energy of the reinforced rubber, however, reduced the amount of ripping.

These patterns suggest that the abrasion by the Schallamach needle involves friction and rupture resistance. If the friction between the small roll of gouged rubber and the needle were sufficient and the compound strength low enough, a chunk of rubber would be ripped from the surface. Extensibility of the rubber would also be important since the amount of work required to rupture the rubber would be dependent on extension. The abrasion of the rubber compound can then be postulated to be a function of the intersurface friction and the resistance to rupture.

Development from Schallamach

During our first experiments with Butyl rubber abrasion and also with tire wear, it was puzzling that Butyl should give as great and sometimes greater resistance to abrasion than a compounded, 41° F. GR-S. The GR-S compound would always have a greater energy

of rupture than the best GR-I compound that could be made. This point is illustrated in Figure 16 where the energy or work of rupture is depicted by the area under the stress-strain curves. A representative GR-S compound has a rupture energy expressed in joules per square centimeter of almost twice as reasonably good Butyl tread compound. By this criterion, then, Butyl should rupture or abrade to a greater extent than GR-S. Our experience does not confirm this supposition. To resolve this anomaly the property of dynamic softness must be introduced into the Schallamach concept, which has been extended to a rough surface in Figure 17.

The rough surface can be likened to an area filled with needle points. In part A of Figure 17 a dynamically hard rubber is pictured. This material will tend to ride on the points of roughness so that load per unit contact area is high. Gouging then would be facilitated.

In part B a dynamically softer rubber is depicted conforming more to the surface roughness. Load per unit contact area is decreased. The more pliable rubber would have less tendency to be gouged provided rupture resistance is not impaired.

The abrasion of rubber then will be related to function of surface friction, strength of the material, and degree of dynamic hardness. These variables have been set up in the following empirical equation:

$$\text{Abrasion loss} = \frac{\text{Dynamic Modulus} \times \text{friction}}{\text{Strength}}$$

Strength = Area under stress-strain curve which is the rupture energy, R, in joules.

Dynamic Modulus = K, dynes/cm^2—determined under forced vibration—10% extension and 16 cycles per second.

Friction = is related to electrical energy to the magnetic brake of the abrader. This is given in amperes since a constant D.C. voltage is used.

The equation then becomes:

$$\text{Abrasion loss/amp.} = \phi \, K/R$$

$$\text{Cc/km/amp.} = \phi \, K/R$$

Where ϕ is a proportionality constant.

In simple terms, then, this concept states that what is needed for best abrasion resistance is a soft yet tough material.

Compound Properties and Abrasion

The above concept is the route by which improvements in abrasion of Butyl compounds have been sought. As will be pointed out in the following section, mixing procedure, compounding ingredients, and state of vulcanization affect the ratio of K/R and thus the resistance to abrasion. It must be admitted at this point that the physical properties of the compounds were determined at rates of deformation different from those encountered in the high-speed operation of a tire tread. The rupture was determined at extension rates of 20 inches per minute and dynamic modulus at 16 cycles per second. These conditions were dictated by the equipment available. However, as the data in the remaining sections indicate, the correlations between the ratios of K/R, so determined, and abrasion losses do show definite trends.

Heat Treatment

This relation explains why the heat treatment[9] of Butyl carbon black mixtures is beneficial to tread wear. Its sole function is to reduce the dynamic hardness of the vulcanized compound. The ratio of K/R is thus reduced, which predicts a lower abrasion *loss*. Repeated experiments have confirmed this prediction. An example of this change of properties is shown in Table 3.

TABLE 3

Compound	Dyn. Mod. Dynes/Cm^2	Rupture Energy, Joules	K/R $\cdot 10^5$	Abrasion Loss Cc/Km/Amp. 18% Slip
Control Mix GR-I-17,* MPC Channel Black	6.0×10^7	131	4.6	.39
Heat Treat Mix GR-I-17* MPC Channel Black	5.1×10^7	130	4.0	.27
GR-S, Tread	7.7×10^7	180	4.2	.28

* Enjay Butyl 217.

Heat treatment reduces dynamic modulus with no change in rupture energy. The ratio of K/R is reduced to the same degree as the reduction in abrasion loss. The GR-S tread compound fits into the relation. Its very high rupture energy is balanced by a relatively high dynamic modulus. The resulting ratio of K/R, as well as the abrasion loss, is similar to a good-grade Butyl tread.

Random Tire Tread Compounds

The mixing, compounding, and curing changes that can be made with Butyl can markedly affect the abrasion resistance. This condition can be shown quite graphically with a group of seven compounds mixed for tire tread purposes. They contain 50 parts of MPC channel black from two different sources and embrace a wide variation of mixing techniques. Their respective ratios of K/R and abrasion losses are spotted graphically in Figure 18 as solid circles, numbers 1 through 7. Although somewhat scattered, the pattern of points extends from low loss and low K/R to high loss and high K/R values. Points 6 and 3 represent heat treated mixes wherein care was taken to maintain the extensibility or elongation of the subsequent vulcanized compound. Points 1 and 2 are control mixes. Points 4, 5, and 7 represent mixes that result in low dynamic moduli, but the extreme mixing conditions have dangerously lowered extensibility, which in turn reduces rupture energy.

The hollow circles A, B, C, and D are representative cold rubber GR-S treads. Points A and C are GR-S treads with MPC and SAF carbon black, respectively, with very high rupture energy. Point B is a GR-S compound purposely vulcanized to a low extensibility by adding three parts of sulfur, which is an excessive amount. The lowered rupture energy increases the ratio

[9] A. M. Gessler, *Rubber Age (N. Y.)*, 74, 1, 59 (1953).

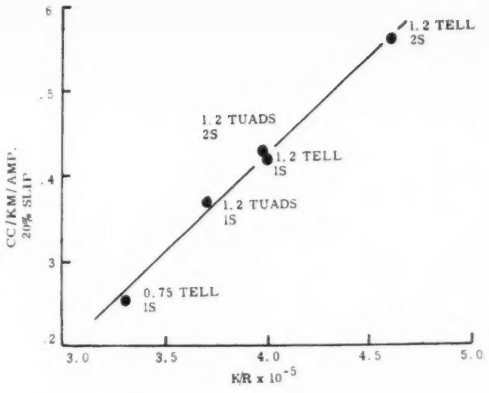


Fig. 19. Effect of state of cure of Butyl tread compounds on abrasion

of K/R and increases the abrasion *loss*. The same is true for point D where the GR-S tread is cured with only one part of sulfur. Unlike Butyl, reduction of sulfur to one part in GR-S treads results in lowered rupture energies.

Solid circle Y, in the extreme lower left of Figure 18, represents an attempt to cure a heat treated Butyl so that optimum extensibility and rupture energy are insured. This vulcanizate from one part of sulfur and 0.75= parts of Tellurac[10] represents an improvement over the better Butyl vulcanizates as well as the GR-S reference compounds. It is quite possible that Butyl tires produced so far may have been overcured from the standpoint of abrasion resistance.

State of Vulcanization

Figure 19 shows just how sensitive a Butyl tread compound is to changes in state of cure. This figure represents a series of compounds prepared from the same masterbatch of Butyl and channel carbon black. Extent of cross-linking was controlled by the amount of curatives (sulfur and accelerator) added to the compound after heat treatment. Reducing the sulfur content limits the extent of cross-linking that can be obtained, and extensibility is therefore maintained even at long cure times.

Figure 20 displays two stress-strain curves of the same Butyl-carbon black mixture. The one showing the

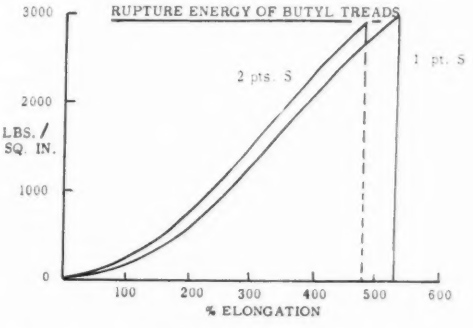


Fig. 20. Rupture energy of Butyl tread compounds vulcanized with one part and two parts of sulfur

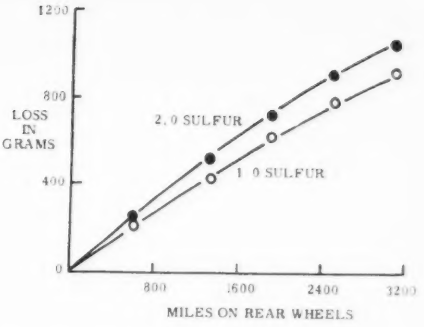


Fig. 21. Weight loss of Butyl tire treads during road wear tests

greater rupture energy (greater area under curve) is vulcanized with only one part of sulfur. This feature is important in the vulcanization of large articles wherein the surfaces are subjected to high vulcanization temperatures for longer periods of time than the centers. Since Tellurac is such an efficient catalyst for the addition of sulfur to polymer, reduced concentrations of this compound are recommended for optimum abrasion resistance.

Road tests on Butyl tire treads have confirmed the superiority of Butyl compounds whose degree of cross-linking has been minimized by reduced sulfur contents. Figure 21 shows the results of a tread wear test conducted on just the rear wheels of a car. Tires were alternated left to right and weighed every 600 miles. The compound with only one part of sulfur consistently showed about 15% lower abrasion loss. Laboratory abrasion may show as much as a 30% advantage for a compound with reduced sulfur. Another road wear test wherein tires were rotated to all four wheel positions again showed the advantage of reduced sulfur dosages. After 4,000 miles, abrasion loss values are shown in Table 4.

TABLE 4. SULFUR CONTENT AND ROAD WEAR—50-PART MPC TREAD

2 Parts S	—	1221 cc loss
1 Part S	—	1044 cc loss

[10] Tellurium diethyl dithiocarbamate (R. T. Vanderbilt Co.)

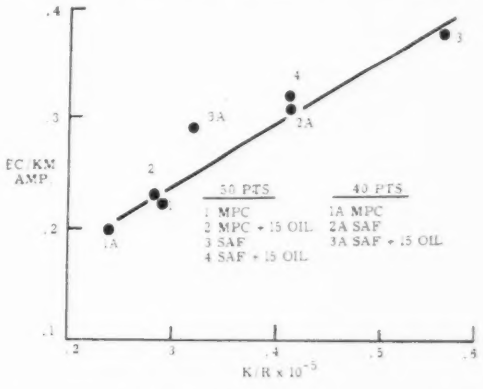


Fig. 22. Effect of compound changes, carbon black type and plasticizer, on abrasion losses of Butyl rubber treads

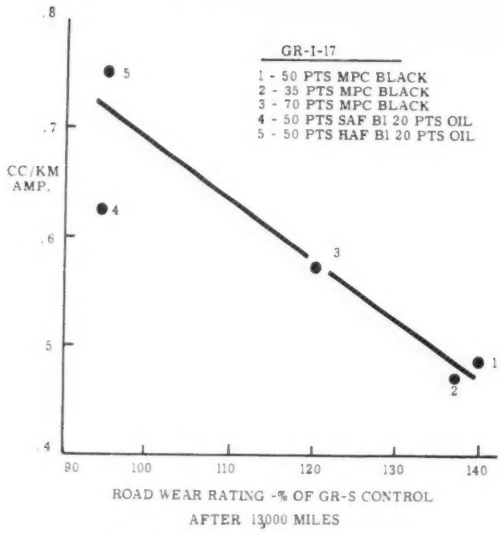


Fig. 23. Correlation between laboratory abrasion losses and road wear ratings for various Butyl rubber treads

These tests were made under severe conditions of braking and cornering.

Effect of Plasticizers and Carbon Black

The tensile properties and dynamic behavior of Butyl can be markedly changed with additions of plasticizer oils and variations in carbon black type. These wide changes in strength and dynamic softness produce the wide variation in abrasion losses observed in Figure 22. This series of seven compounds, with the compounding changes listed in the small table that accompanies the figure, follows rather closely the relation of abrasion loss and ratio of K/R. Since SAF carbon black (50 parts) produces such dynamically hard compounds, the presence of oil plasticizer makes a great change in the abrasion losses observed. This is observed when points 3 with 4 are compared. With MPC channel carbon black the presence of oil has little effect on abrasion loss, because the ratio of K/R, as shown by points 1 and 2, has not been changed. Point 1A, with 40 parts of MPC carbon black represents a

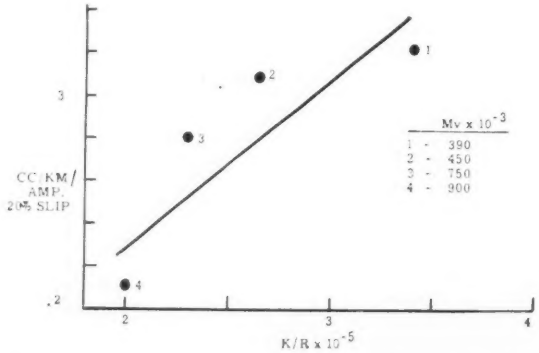


Fig. 24. Relation between Butyl rubber molecular weight and abrasion loss of tread compounds

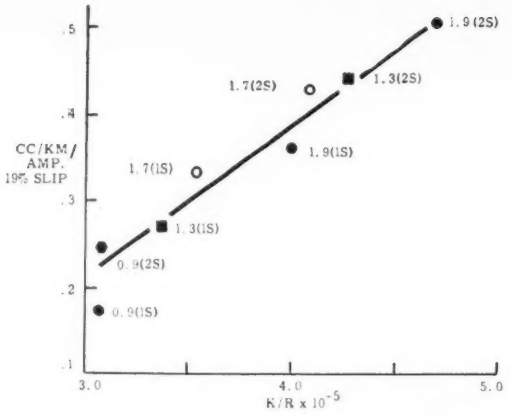


Fig. 25. Polymer unsaturation and abrasion loss of Butyl rubber treads

good balance between rupture energy and dynamic softness.

Although the main purpose of the laboratory work is to evolve some general principles of abrasion to guide our experimental work, some correlation with actual road wear is of interest. Laboratory abrasion values obtained with compounds actually placed on road tests in Texas have given a confident degree of correlation. In Figure 23, for example, the laboratory abrasion loss of five compounds incorporating changes in carbon black and oil content is related to road life ratings expressed as a % of a GR-S commercial control. With these road rating values a high number is superior; while our laboratory tests were expressed in actual volume losses. Here a low number is desirable. The values plotted appear to be good correlations in this inverse fashion.

Polymer Variables and Abrasion

Since abrasion is a rupture process, the more perfectly vulcanized network should result in lower abrasion losses. Even micro flaws can be points of rupture initiation. A reduction in network flaws would result in higher rupture energies with no increase in hardness.

Molecular Weight

One way to achieve higher rupture energies without an increase in dynamic hardness is to raise the molecular weight of the polymer. In fact the more perfect vulcanized network obtained with a high molecular weight polymer would tend toward improved hysteresis properties. A series of increasing molecular weight Butyl polymers confirms the advantages of higher molecular weight. Four polymers were compounded with 50 parts of MPC channel black and three parts of a hydrocarbon oil. Only one part of sulfur was used to minimize differences in unsaturation with the conventional 1.2 parts of Tuads as an accelerator. The polymers used and their compounded properties are given in Table 5.

A plot of abrasion loss and K/R, in Figure 24, predicts that an improved wear-resistant tread could be produced from high molecular weight Butyl.

(Continued on page 76)

Rubber Has Dynamic Properties Too[1]

By RALPH P. SCHMUCKAL
Ford Motor Co., Detroit, Mich.

Although there has been published since 1952 by both the Society of Automotive Engineers and the American Society for Testing Materials a recommended practice for determining the dynamic properties of rubber by means of the Yerzley oscillograph, the method is apparently not used by any automotive company.

Both the constant-deflection and the constant-load method have been used to estimate the durability of automotive engine mounts, but the two methods give contradictory results.

The constant-dynamic-energy method of testing, as developed at Ford Motor Co., represents a new concept of performance testing by which engine mounts are neither favored nor penalized because of differences of dynamic rate. The new method may be applied, with modifications, to nearly all dynamically functioning rubber components.

FOR 50 years rubber has been a most vital material of the automotive vehicle. During all this time we have been concerned principally with the *static* properties of rubber. But rubber has *dynamic* properties too!

Specifications usually are written around static properties, even for such materials and components that function strictly on a dynamic basis in the vehicle. Relatively speaking, rubber is a variable, unpredictable thing. Its characteristics under dynamic conditions cannot be predicted reliably or controlled adequately by any means other than dynamic testing. It is with dynamic testing, dynamic properties, and the control thereof that this discussion is concerned.

Progress in Dynamic Testing

Radiator hose testing by static means is no longer adequate. Even static burst pressures are but poor indications of fatigue life characteristics. Superior fatigue life has become a necessity with the advent of high-pressure cooling systems. Consequently many hoses now are evaluated in the laboratory on special dynamic test machines designed to simulate actual severe service conditions. In these tests hot coolant circulates continuously through a vibrating hose in a pressurized system.

We at Ford intend to go one step farther and include a condition of surging between two pressure levels to create a breathing effect throughout the test. One company reportedly is obtaining good fatigue life indication merely by repeated surging between partial vacuum and pressure conditions.

V-Belts

V-belts, from their very beginning, have been evaluated dynamically on test vehicles or on laboratory accelerated life test machines. Since the amount of vehicle testing necessarily is limited, the burden falls upon the laboratory.

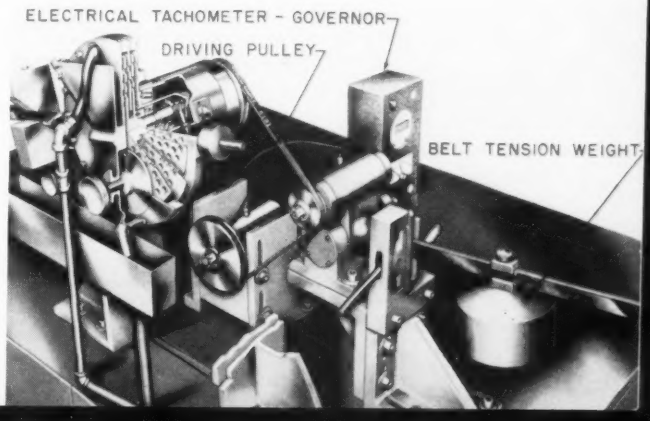
A V-belt is a composite of materials, constructions, and processing techniques. Dependable evaluation of such an intricate combination can be obtained only by dynamic testing to pick out the "weakest link," so to speak. Laboratory simulation of the actual belt drive in the vehicle is ideal in some respects, but presents many problems. A major automotive producer may find it necessary to duplicate about two dozen drives to handle original equipment alone. Service belt testing adds to the complication. The arrival of such a large number of belts from numerous suppliers periodically throughout the year creates an "impossible" situation. Simulated drive testing under such circumstances is inefficient, costly, and extremely impractical.

Our answer to this problem at Ford has been the development and company-wide adoption of "standardized belt testing." Four standard laboratory drives now handle all belts, regardless of size, horsepower loads, or pulley configurations on the vehicle. One of the four is applicable to any conventional belt drive and obviates the necessity of duplicating exact vehicle geometries. Figure 1 illustrates one such standard test machine.

Standardized testing is used for quality level determinations of belts for both source approval and quality control, which constitute at least 90% of belt testing. The accumulation of data on standard tests usually permits *immediate* formulation of specifications for new drives. Specific testing for any particular drive is seldom required. Questionable experimental drives, however, continue to be evaluated on simulated vehicle configura-

[1] Presented before the meeting of the Society of Automotive Engineers, Sheraton Cadillac Hotel, Detroit, Mich., Mar. 1-3, 1955.

Fig. 1. Typical Ford Motor Co., standard V-belt test machine



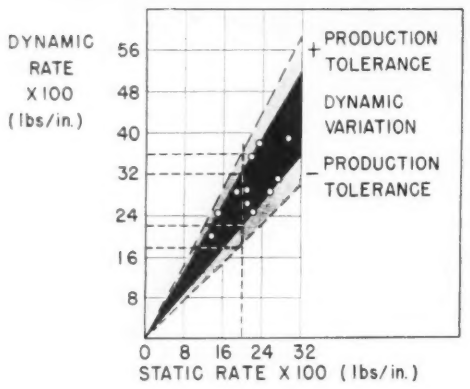


Fig. 2. Static vs. dynamic rates of engine mounts (shear direction). The width of the solid band shows the variations in dynamic rate that can be obtained for any given static rate

tions under simulated vehicle operation conditions. Once the drive in question has proved satisfactory, however, standardized testing henceforth is used.

In recognition of the need of standardized belt testing, an SAE-ASTM technical committee[2] recently developed a standard belt performance test. It is described in the SAE handbook as a recommended practice under "Automotive B-Belt Drives," page 908, 1954 edition. Standardized belt testing is here to stay!

Suspension Bumpers

Suspension bumpers are evaluated by laboratory impact tests. Bumper specifications now usually include a life requirement under rigidly controlled impact test conditions. The following example will indicate the dependability of impact testing in the determination of bumper quality. Five specimens of oil-extended neoprene bumpers, compounded with varying amounts of loading material, were subjected to comparative impact tests. The machine rated the bumpers with respect to quality in the exact order of their compounding costs; the more expensive the bumper, the greater its life.

Durability of bumpers, however, is not enough. "Car feel" is important and depends upon bumper flexibility and possibly upon resilience. Bumpers under impact are always stiffer—sometimes greatly stiffer—than under a slow deflection. It appears that dynamic stiffness should be controlled and made a requirement for those bumpers which contribute significantly to the ride characteristics of the vehicle. To permit further study along this line, bumper impact testers should be instrumented to measure dynamic rates and hystereses under various conditions of impact. We are working on this instrumentation problem at the present time.

Rubber Bushings

Rubber bushings also act dynamically. It is interesting to note the extent to which rubber bushings affect the rate of a set of leaf springs. It is found that rubber bushings appreciably influence the stiffness of the system, increasing it by as much as 15% at full jounce or rebound. Vehicle ride is very sensitive to suspension rates. The dynamic rate of the rubber bushing probably should be seriously considered. However it probably has been completely overlooked.

Engine Mounts

Durability testing of rubber components is not new; however, testing techniques are improving rapidly. But on numerous rubber items, durability is not enough. Rubber must often isolate noise, insulate vibrations, act as cushions to shock loads, etc., and thus improve the overall ride characteristics or "car feel." The engineer selects the best performing experimental rubber item—be it a mount, bushing, prop-shaft support, or axle bumper—by actually road testing the vehicle. The specifications finally formulated for control purposes, however, usually are based upon static properties, such as tensile, elongation, hardness, permanent set, etc. Seldom is it recognized that there is no reliable correlation between such static properties and dynamic properties. By dynamic properties we usually mean dynamic stiffness and resilience or hysteresis (a measure of damping).

The engine mount is the second most important rubber item on the vehicle. The tire, of course, must be given first consideration. The mount, however, is the most highly functional from the dynamics standpoint. Therefore it will serve as an excellent example in our discussion of the dynamic properties of dynamically functioning rubber components.

For pioneering in this field and awakening the industry to the importance of dynamic properties of engine mounts, much credit is due Lloyd E. Muller, of Buick Motor Division, who, incidentally, presented an SAE paper on the subject back in 1947. Considerable work, however, has been done since that time, and we think it desirable to present some further enlightening information regarding (a) static *versus* dynamic properties, (b) measurement and control of dynamic properties, and (c) the Ford "constant-dynamic-energy" method of engine mount evaluation.

Static vs. Dynamic Stiffness

Durometer hardness alone was used for years to control the flexibility of an engine mount. More re-

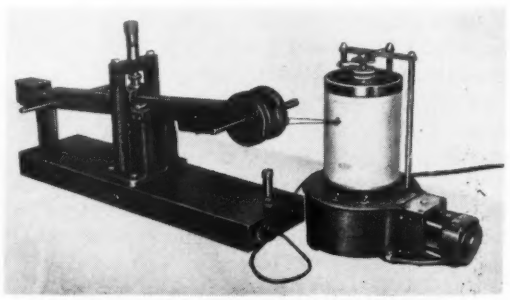


Fig. 3. Yerzley oscillograph, as recommended for use by the SAE and the ASTM since 1952, for determining dynamic properties of rubber compounds

[2] Section VI (V-Belts) of SAE-ASTM Technical Committee on Automotive Rubber.

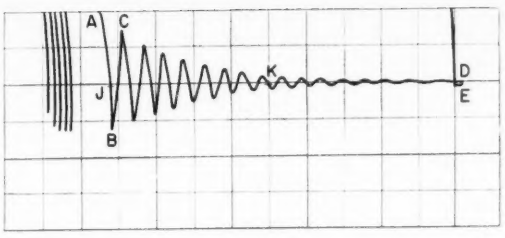


Fig. 4. Typical Yerzley oscillogram from which values of dynamic modulus and resilience may be determined

cently, the inadequacy of such a control of flexibility was recognized, and durometer hardness was superseded by a static flexibility check. The static load-deflection curve of the preferred mount, together with appropriate tolerances often was made a requirement of the mount. Sometimes a one-point check was used, which required a certain deflection under a given static load. The change from durometer control to static rate control constituted a big step in the right direction.

Control of flexibility also has been recognized for some time, however, as being inadequate; but, with few exceptions, companies continue to employ *static* flexibility checks. Possibly this practice has been retained because of the convenience and simplicity of conducting static tests. Or, perhaps the magnitude of the variations between static and dynamic stiffness has not been realized or emphasized sufficiently. At any rate the following brief summary of one phase of a current Ford investigation may be enlightening.

Static vs. Dynamic Test Differences

Rubber compounds suitable for engine mount applications, but differing considerably in dynamic properties, were used in the fabrication of experimental mounts of the 1955 Mercury front-engine mount design. The mounts were in various combinations of high, medium, and low resilience and high, medium, and low dynamic stiffness. Static shear rate checks (lbs./in.) were made on a dead-weight type of machine with a 300-pound test load.

The dynamic rates of the same mounts were then measured on the Ford engine mount dynamic test machine, a description of which follows later in this paper. Under identical loads, when vibrating at 1800 cpm, the mounts invariably were stiffer than under static conditions.

How much stiffer? Refer to Figure 2 to see the correlation, or rather lack of correlation, between static and dynamic stiffness of actual engine mounts. Each coordinate point, representing a test of an individual mount, shows both the static and dynamic shear rates of the mount. The non-correlation is obvious and somewhat amazing. The width of the solid band clearly depicts the variations in dynamic rate that can be obtained for any given static rate.

These data are completely realistic in that only practical engine-mount stocks (complying with SAE-16R classifications of resilient automotive mounting compounds) were used. It is seen from the graph, for example, that a mount with a static rate of 2000 lbs./in. may exhibit a dynamic rate anywhere between 2200 and 3200 lbs./in. Percentagewise, this amounts to a dynamic rate increase from 10 to 60% over the static rate. In addition, practical production tolerances in static rates usually are about ±15% of the preferred. Since any percentage variation statically may cause a similar variation dynamically, the correlation grows correspondingly worse. Therefore the band in Figure 2 widens when the effects of production tolerances are included. With a static rate of 2000 lbs./in. preferred, the dynamic rates then may vary from 1870 to 3680 lbs./in.

Believe it or not, therefore, two mounts may be received which comply with the ±15% static tolerance; yet one may be twice as stiff dynamically in actual vehicle operation. Consequently how can we ignore dynamic properties? Possibly this point explains some heretofore "unexplainable" phenomena encountered by automotive engineers in "ride" and "car feel" investigations.

Importance of Hysteresis

Variations in hysteresis or resilience appear to be the principal cause of dynamic rate differences. Generally speaking, the greater the hysteresis, the greater the difference between static and dynamic rates. But hysteresis, a measure of damping, also affects vibration since it has a significant influence upon the transmissibility of forces through the mounts. In engine-mount work, dynamic rate and hysteresis are the two factors that control vibration and contribute most greatly to the all-important "car feel" that rates a position of importance these days next only to upholstery, horsepower, and sex appeal.

Method of Specifying Dynamic Properties

The importance of static properties in the evaluation of rubber quality cannot be discounted; but for engine mounts, and many other dynamically functioning rubber parts, such specifications are inadequate. As previously shown, even static flexibility checks are inadequate and could be met by an unlimited number of compounds, all of which could have different dynamic properties.

This fact has long been recognized by a joint SAE-

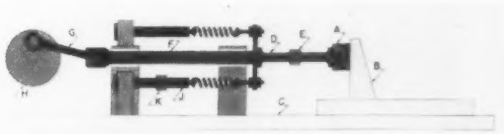


Fig. 5. Schematic drawing of mechanical stroker of constant-deflection machine. The stroke is controlled by the setting of the eccentric, not by the stiffness of the mount

A—test specimen. B—bracket. C—base plate. D—load recording tube. E—strain gages for measuring load. F—reciprocating rod. G—crank. H—eccentric (adjustable). J—stroke recording tube. K—strain gages for measuring deflection

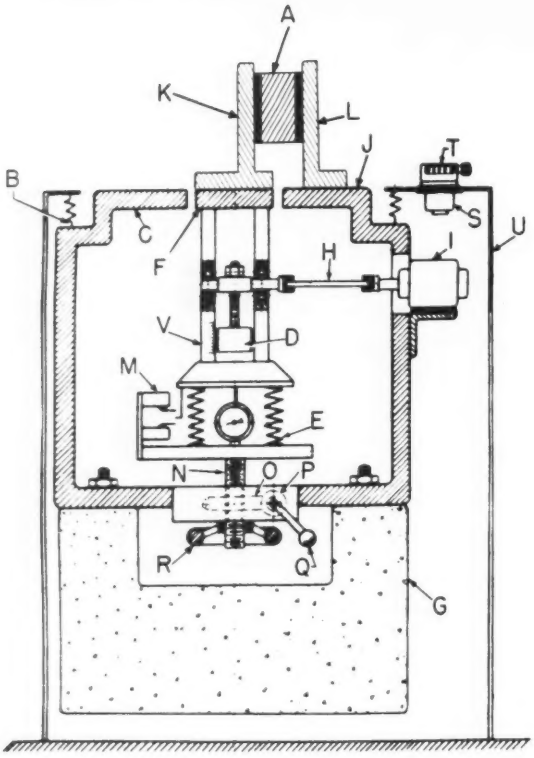


Fig. 6. Schematic drawing of stroking mechanism of constant-load machine. The load is controlled by the setting of the revolving eccentric weight, not by the stiffness of the mount

A—test specimen. B—seismic mount for vibration isolation. C—frame. D—mechanical oscillator. E—springs for preload and inertia force compensation. F—reciprocating platen. G—concrete stabilizing block. H—flexible drive shaft. I—synchronous electric motor. J—stationary platen. K—reciprocating fixture. L—holding fixture. M—micro-switch cut-off. N—preload adjusting screw. O, P, Q—worm drive for preload adjustment. R—lock wheel for preload screw. S, T—cycle counter. U—sheet metal housing. V—scale for indicating magnitude of oscillator force

ASTM technical committee.[3] Efforts of this committee resulted in the publication in 1952 of an SAE recommended practice (SAE-16R) which set up the mechanics for specifying dynamic properties of basic rubber stocks used for resilient mountings.

The system permits control of both dynamic modulus and resilience as measured on standard laboratory specimens with the industry standard Yerzley oscillograph (see Figure 3). The Yerzley gives an oscillogram (see Figure 4) from which are determined the values of dynamic modulus and resilience. Dynamic modulus is the ratio of unit stress to unit deformation. Resilience is a measure of the hysteretic efficiency of a compound. It is the inverse of hysteresis; for example, a 70% resilient stock has 30% hysteresis.

The system uses a series of numbers and letters in specifying dynamic properties of elastomeric materials. Although available for more than two years, it apparently is not used by any automotive company.

A description of the system and its use is contained in both the SAE and ASTM handbooks.[4] The system has been developed to fill a very definite need, and we have much to gain by taking advantage of it.

Dynamic Performance Testing of Engine Mounts

Years ago laboratory dynamic testing of an engine mount usually consisted of repeated deflections on a punch press. More recently, dynamic evaluation of a mount has become more scientific. Electronically instrumented equipment now is used to measure simultaneously the durability, dynamic stiffness, and resilience of the mount. Controlling quality with respect to durability, dynamic rate, and resilience controls just about everything of importance to an engine mount—both endurance and "car feel" characteristics.

On electronically instrumented equipment, dynamic rate and % resilience may be obtained from the hysteresis loop shown on the screen of a cathode ray oscilloscope. Although minor differences exist between companies in the instrumentation techniques of obtaining the loop, results apparently agree satisfactorily. With respect to the durability phase of the testing, however, such close agreement is lacking. Different machines give contradictory results.

Two types of engine mount dynamic testing equipment are used most extensively in the industry. One utilizes the principle of constant deflection; the other, the principle of constant load.

Constant-Deflection Machine

A schematic drawing of the mechanical stroker of the constant-deflection machine is shown in Figure 5. The *stroke* is controlled by the setting of the eccentric, not by the stiffness of the mount.

All mounts for a given application, regardless of variations in hardness or dynamic rate, are tested with the same constant deflection. Consequently a more flexible mount is subjected to a lower load than is a stiffer mount. In addition, as the test progresses and the mount weakens owing to localized failure or general fatigue, the load applied gradually falls off. Further cycling is performed under an ever-decreasing load.

Obviously, when two mounts have comparable rubber quality, but different flexibility, the constant-deflection type of test invariably will make the more flexible mount look best. In other words—the more flexible the mount, the greater its life.

Constant-Load Machine

A schematic drawing of the stroking mechanism of a constant-load type of machine is shown in Figure 6. The *load* is controlled by the setting of the revolving eccentric weight, not by the stiffness of the mount.

The basic unit used for obtaining the reciprocating motion is generally a Sonntag[5] vibrator. It employs a synchronous motor to drive an unbalanced rotating mass

[3] Section I (Automotive Insulators) of SAE-ASTM Technical Committee on Automotive Rubber.

[4] "SAE Handbook," Society of Automotive Engineers, 29 W. 39th St., New York 18, N. Y. "ASTM Standards on Rubber Products," American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

[5] Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa.

which is in a cage-like vertical frame, the top of which forms the reciprocating platen. The machine, properly tuned, induces an alternating force in the mount equal to that produced by the oscillator and remains so, irrespective of the rigidity of the mount or the amplitude of vibration.

On this machine all mounts for a given application are tested with the same predetermined constant load, regardless of variations in flexibility. Obviously a flexible mount will be deflected a greater distance than a stiff mount. In addition, as the test progresses and the mount weakens, the load remains constant, and the deflection grows. Further cycling is performed under an ever-increasing deflection. Therefore, with the constant-load principle of test, the stiffer mount will invariably look better. In other words, the stiffer the mount, the greater its life, according to this method of testing.

Reason alone tells us, therefore, that the two machines give completely contradictory results with respect to durability of engine mounts. The constant-deflection machine favors the soft mount; the constant-load machine favors the hard mount. The mount that looks better on one machine looks worse on the other. Actual laboratory testing substantiates this conclusion.

Test Data—Constant-Load Machine

At Ford Motor Co. the constant-load test method was used for several years in the belief that it more closely simulated the conditions of operation in the vehicle. Using this test, Ford front-engine mounts gave widely variable fatigue life characteristics, depending upon their flexibility.

As shown in Figure 7, the mounts were tested under a 300-pound compressive load and a constant 300-pound reversible dynamic shear load. Figure 8 shows the results of these tests. Fatigue lives range from three to more than 300 hours. This curve shows a definite relation between flexibility and fatigue life; the more flexible the mount, the shorter its life. When compared to hard mounts, the soft mounts looked so inferior that they didn't even warrant further consideration. Because of the evaluation from such laboratory testing, our design engineers took no chances and purposely steered clear of soft mounts in our vehicles.

Subsequent vehicle testing, however, gave no indication that these softer mounts failed prematurely in actual service or on cobblestone tests. The softest mounts, which showed the poorest life on the constant-load laboratory test, completed 1,100 trips without any signs of failure over the cobblestone section of our test track. Harder mounts performed likewise.

Extensive vehicle testing indicated that mount failure usually could be traced to some fabrication defect, such as inferior bond, improper cure, etc., and not to the flexibility of the mount. Prolonged operation over severe chuck-hole roads was found to be the only vehicle operating condition that would at times fail a good mount. But no tie-in with mount flexibility was ever indicated over the hardness range of our experimental work. It had to be concluded that no direct correlation exists between laboratory tests under constant-load conditions and actual service performance. In fact, unless properly analyzed, the results of such a laboratory test could be seriously misleading.

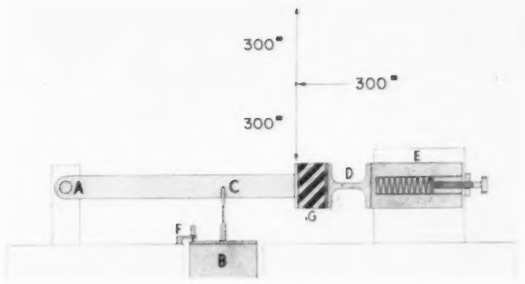


Fig. 7. Fixture and loads for fatigue testing engine mounts at Ford Motor Co. by the constant-load method

A—pivot point representing torque roll axis of engine. B—reciprocating platen of Sonntag machine. C—flex plate. D—cantilever beam upon which strain gages for force pick-up are mounted. E—fixture for applying compressive force to test specimen. F—displacement pick-up. G—test specimen

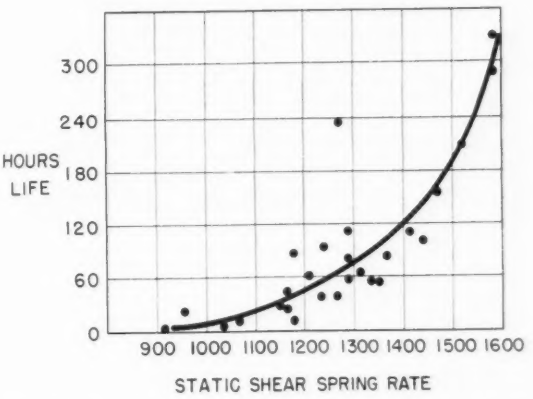


Fig. 8. Mount life vs. spring rate—constant-load tests

The constant-deflection type of machine is no better. Although no actual data were obtained in our laboratory with the constant-deflection type of machine, it is reported by users of the machine that just the reverse picture of the findings with the constant-load machine resulted. With comparable rubber quality, the softer mount invariably outperforms the stiffer mount.

The realization that laboratory durability tests were not telling the true story presented a real problem. Production tolerances demanded that mount flexibility be permitted to vary by as much as $\pm 15\%$, which allowed some mounts to be 30% stiffer (statically) than others. This 30% variation in stiffness had a tremendous effect upon durability on a constant-load test. We were putting ourselves in a position of approving a mount of possibly lesser quality merely because it was stiffer. So, which principle of test, constant-load or constant-deflection, was to be utilized? Which simulated service conditions more closely? An analysis of the problem indicated to our satisfaction that both had serious shortcomings and disadvantages, and that an entirely different principle was decidedly superior to either: namely, the principle of constant-dynamic-energy.

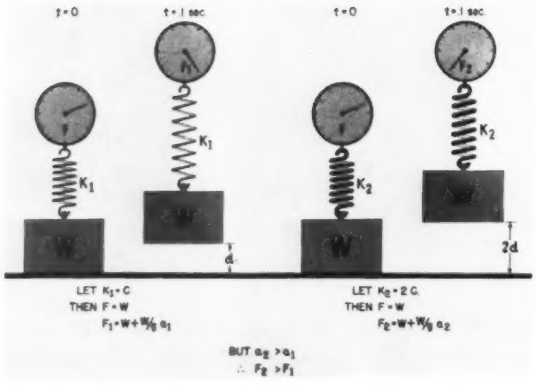


Fig. 9. Comparison of forces involved in lifting a given mass with springs of different rate

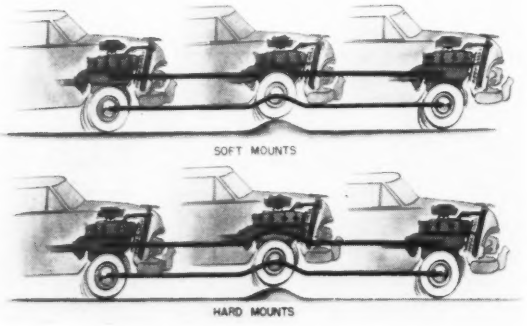


Fig. 10. Diagram showing greater deflection of soft engine mount on road bump

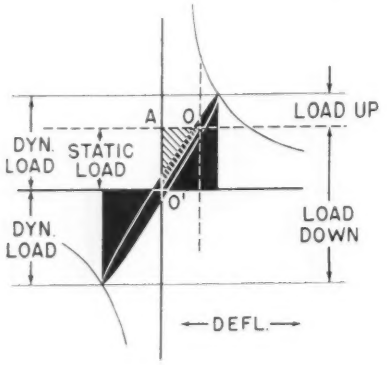


Fig. 11. Graphical illustration of constant-dynamic-energy principle. The shaded areas represent the dynamic energy input to the mount per cycle in deflecting it in both directions from the static neutral

Constant-Dynamic-Energy Principle

We were led into the idea of constant-energy by considering, as somewhat analagous to the engine-mounting system in the vehicle, the simple case of lifting a given mass with springs of different rates (see Figure 9). When the free ends of the springs are jerked upward suddenly to a higher level, the mass on the stiff spring accelerates vertically faster than the mass on the soft spring. Since F = m.a., and the mass is identical in either case, the force in the stiff spring is higher than that in the soft spring.

Since both masses eventually are raised the same amount, however, both springs will have done the same amount of work. The stiff spring merely does it faster; therefore, with a greater force. The deflection of the stiff spring is correspondingly less. Likewise in the vehicle, a stiff mount raises the engine more suddenly and in so doing, deflects less and carries greater loads.

Generally speaking—that is, disregarding certain irregularities encountered in vibrations under some conditions—the more rigidly the engine is tied to the frame, the greater are the forces to which the mountings are subjected. As a vehicle passes over a bump (see Figure 10) or through a chuck-hole, the soft mount acts as a cushion to the shock loads. A block of steel, used as an engine mount, would have no cushioning effect, no deflection, and consequently would be subjected to very high engine-mass acceleration forces caused by the road bump. A soft rubber mount, by its greater deflection, absorbs the shock and is used as a vibration insulator for this reason.

All considerations seemed to indicate that laboratory tests should be made on the basis of energy control. It became increasingly obvious that hard and soft mounts on vehicles were not subjected to the same deflections. Scratch graphs on vehicles proved soft mounts to deflect more than stiff mounts. The constant-dynamic-energy method of testing likewise deflects soft mounts more than stiff mounts. Transmissibility of forces through stiff mounts on the vehicle is greater than through soft mounts, meaning the stiff mounts are subjected to greater forces. Similarly, the constant-dynamic-energy method of testing subjects stiff mounts to higher loads. Both load and deflection are permitted to vary with the flexibility of the mount, as we know they vary on the vehicle itself.

Constant-Dynamic-Energy Principle Definitions

The weight of the engine on the mounts subjects all mounts for that application to the same load regardless of their flexibility. Potential energy is thus stored in the mount. The softer the mount, the greater its deflection, and, of course, the greater this potential energy. This energy is permitted to vary on the test as it varies in the vehicle. Static loads on the mount during testing are made equal to those caused by the static weight of the engine on the mount in the vehicle. But superimposed upon this static force condition are dynamic forces reciprocating above and below the static neutral and of such varying magnitude that the desired constant dynamic energy input to the mount per cycle is maintained.

This test condition is shown graphically in Figure 11. The origin, O, of the dotted coordinate axes represents the true zero load point of the mount. The static load deflects the mount to the so-called "static-neutral" point O^1. In deflecting the amount to O^1, the energy measured by the cross-hatched area OO^1A is absorbed by the mount. This energy varies with the flexibility of the mount. A larger reversible dynamic force is then applied

around the static neutral point O^1, the origin of the transposed axes. The reciprocating dynamic force forms the hysteresis loop. The shaded areas represent the dynamic energy input to the mount per cycle in deflecting it in both directions from the static neutral. It is this energy that is maintained constant from one mount to the next and throughout the test of an individual mount, irrespective of its rate.

A mathematical analysis substantiating the theory of constant-dynamic-energy has been made. It is based upon the theory of velocity shock as representing the condition encountered at a bump or pot-hole. In negotiating a given road irregularity, the chassis is forced into a certain displacement with a certain vertical velocity which is independent of the flexibility of the resilient mounting. The dynamic-energy input for any mount during its deflection is shown to be constant.

Other Factors

Truly, there are fixed forces acting upon a mount that are independent of its flexibility, as for example, those due to static engine weight and torque reaction. It was seen that the static forces due to engine weight are applied to the mount, along with a vibrating dynamic load, during the test. But it is the dynamic energy only (that is, energy input caused by a dynamic force) that is maintained constant. We are convinced that the torque reaction forces on the mount are of secondary importance; that they are more or less inconsequential in comparison with the forces of much greater magnitude which occur over bumps and chuck-holes where energy considerations rule.

Graphical Illustrations

Figure 12 illustrates graphically the differences in principle between the three types of test, i.e., constant-deflection, constant-load, and constant-dynamic-energy. Mounts of high, medium, and low stiffness are represented by the respective slopes of the load-deflection curves OA, OB, and OC. Energies stored in the various mounts due to the static engine weight vary as shown by lightly shaded areas beneath the load-deflection curves O to the static load line $X\text{-}X^1$. This potential energy is proportional to mount flexibility and is permitted to vary in like manner on the laboratory test. Reversible dynamic forces, superimposed upon the static forces, form the hysteresis loops, the widths of which are shown equal to zero for purposes of simplification and clarity in presenting the principle only.

In the work triangles (darkly shaded) the base of the triangle represents the deflection; the height represents the load; the area within represents the dynamic energy input per cycle.

With the constant-deflection test (see Figure 12-a), all mounts for a given application are deflected equally. Consequently the dynamic load carried by a stiff mount is higher than that carried by a flexible mount. Comparative energy values show that the stiff mount is worked far more severely than the flexible mount.

With the constant-load test (see Figure 12-b), all mounts for a given application are loaded equally. Consequently the deflection of a flexible mount is higher than that of a stiff mount. Comparative energy values show that the flexible mount is worked far more severely than the stiff mount.

With the constant-dynamic-energy test (see Figure 12-c), the dynamic hysteresis loop always remains within

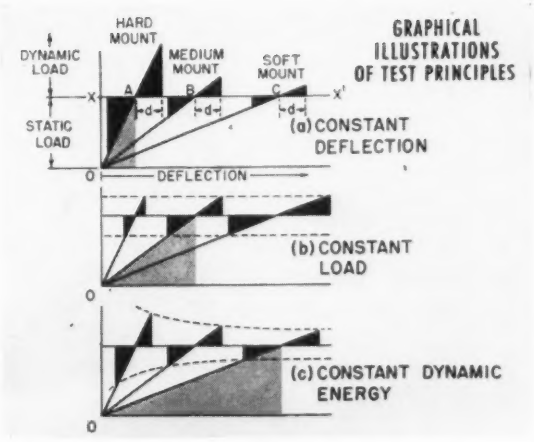
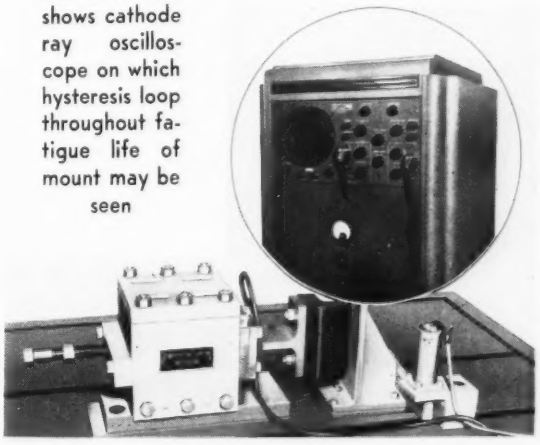


Fig. 12. Graphical illustration of differences between constant-load, constant-deflection, and constant-dynamic-energy methods of test

Fig. 13. Ford engine mount dynamic test machine. Inset shows cathode ray oscilloscope on which hysteresis loop throughout fatigue life of mount may be seen



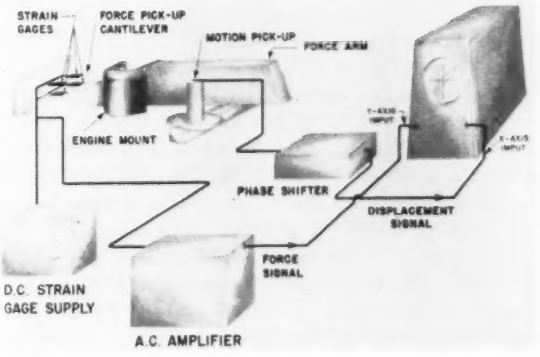


Fig. 14. Schematic drawing of instrumentation used on Ford engine-mount dynamic-test machine

the constant-energy curves. Load and deflection vary in such a manner that dynamic-energy input per cycle is held constant from one mount to the next and throughout the test of an individual mount.

It is apparent, therefore, that the constant-deflection test favors the flexible mount. The constant-load test favors the stiff mount. The constant-dynamic-energy test favors neither. Mounts are neither favored nor penalized because of differences in dynamic rate.

Description of Ford Dynamic Test Machine

A Sonntag machine and test fixture is electronically equipped to show on a cathode ray oscilloscope, the hysteresis loop throughout the fatigue life at the mount (see Figures 13 and 14).

The instrumentation consists of three distinct parts: (a) force measuring device, (b) displacement measuring device, and (c) camera for recording purposes.

The base of the mount is bolted to the free end of a cantilever beam. Strain gages mounted upon this beam pick up instantaneous values of the load on the mount. The strain gages are connected through an A.C. electronic amplifier to the oscilloscope where the signal is visually displayed.

The velocity of the reciprocating platen is converted into an electrical signal by means of an electro-magnetic velocity pick-up. The velocity signal is converted, by means of a phase shifter, to a displacement signal which also is fed into the oscilloscope and visually displayed.

The signals, presented simultaneously on the oscilloscope, give us the force-displacement diagram or hysteresis loop. A suitable camera is used to photograph the pattern on the oscilloscope.

The fixture on which the cantilever beam is mounted, opposite the mount, is used to apply a static compressive force equal in magnitude to that caused by the static weight of the engine on the mount.

The Sonntag machine itself also has facilities for applying a static force to the mount. In our case this force is made equal to the static shear force in the mount caused by the static weight of the engine.

Superimposed upon these static forces is a reversible dynamic force sufficient to give the amount of energy desired per cycle.

One method of maintaining constant-dynamic-energy is by means of so-called "constant-dynamic-energy" curves superimposed upon the screen of the oscilloscope (refer again to Figure 12). After the application of the required fixed static loads, a reversible dynamic load is applied in sufficient magnitude to extend the hysteresis loop, positioned around the static neutral point of the mount, from one constant-dynamic-energy curve to the other. As the mount weakens during the progress of a test, the deflection will grow, and the ends of the loop will move horizontally off the energy curves. Constant-dynamic-energy is restored by reducing the dynamic load a sufficient amount to return the loop ends to the energy curves. When possible, load and deflection measurements may be taken mechanically, rather than electronically, and adjustments made to follow a predetermined load-deflection relation to maintain constant-dynamic-energy.

The constant-dynamic-energy method of testing represents a different concept of performance testing. Existing equipment of both the constant-load and constant-deflection types may be used provided, however, the required adjustments in load or deflection can be made to maintain a constant energy input per cycle.

Summary and Conclusions

This paper has dealt primarily with the engine mount as representative of the dynamically functioning rubber components of the vehicle. It has shown how extremely important the measurement and control of dynamic properties are to engine mount performance. Such study and control, however, should not be limited to engine mounts. The ideas presented here apply, with modifications, to nearly all dynamically functioning rubber components. If the part functions dynamically in the vehicle, remember, rubber has dynamic properties too!

Abrasion of Butyl Rubber

(Continued from page 68)

TABLE 5. PROPERTIES OF BUTYL POLYMERS OF INCREASING MOLECULAR WEIGHT

Polymer	GR-I-15*	GR-I-18†	B439‡	A605‡
Mol. wt. (mv)	390,000	450,000	750,000	900,000
Rupture energy	127	151	176	186
Dyn. Mod. (dynes)x10^{-7}	4.3	4.0	4.0	3.6
K/R x 10^{-5}	3.4	2.6	2.3	2.0
Abrasion loss 20% slip cc/km/amp.	0.32	0.30	0.28	0.21

* Enjay Butyl 215.
† Enjay Butyl 218.
‡ Enjay Butyl Experimental Polymers.

Polymer Unsaturation

Unsaturation in a Butyl polymer limits the maximum extent of cross-linking just like a reduction in the amount of sulfur in the compound. In fact, a polymer of lower unsaturation will duplicate the abrasion resistance of more of the unsaturated varieties wherein sulfur content has been reduced. To show this effect, abrasion results with a series of four Butyl rubbers with the following molecular characteristics have been plotted in Figure 25.

	Mol. % Unsat.*†	Visc. Ave. Mol. Wt.
GR-I (R2) (Enjay Butyl 035)	0.9	325,000
GR-I (Enjay Butyl 150)	1.3	310,000
GR-I-15 (Enjay Butyl 215)	1.7	350,000
GR-I-25 (Enjay Butyl 325)	1.9	325,000

* By iodine-mercuric acetate method.
† S. G. Gallo, H. K. Wiese, J. F. Nelson, "Ind. Eng. Chem.", 40, 1277 (1948).

These polymers were compounded in a tread compound using 50 parts of MPC channel black per 100 of Butyl. Each type of tread was then vulcanized with two parts and with one part of sulfur to make eight vulcanizates in all. Their abrasion loss and respective values of K/R follow the established relation fairly well. Abrasion losses increased with increased unsaturation at any given sulfur dosage. The first number

adjacent to the various points is the unsaturation expressed in mol %. The number and letter in parenthesis in Figure 25 refers to the amount of sulfur. Thus the worst compound from the standpoint of abrasion loss is the one made from GR-I-25 (1.9 unsat.) using two parts of sulfur. Reduction of sulfur to one part, as shown, results in an improvement.

With the other Butyls a step down in unsaturation reduces abrasion losses, and each polymer is further improved by the reduction of sulfur. The very lowest unsaturated Butyl, 0.9% unsaturation, is superior to all others even with two parts of sulfur since extent of vulcanization is limited by the molecular nature.

The questionable value of too low a state of cure is shown in the very last point with one part of sulfur in GR-I (R2). Here a sticky vulcanizate results in an abnormally low abrasion loss. Reduction of unsaturation has, of course, one serious drawback. Rate of cure would be seriously impaired. From an economic standpoint, then, it would be more practical to obtain low abrasion loss with a higher unsaturated polymer vulcanized in the presence of reduced quantities of sulfur.

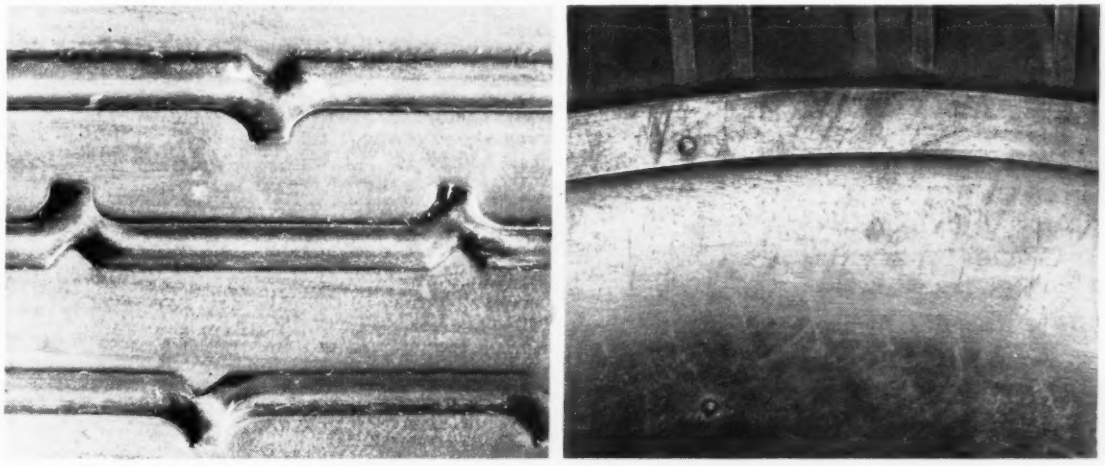


Fig. 26. Close-up of tread and sidewall of experimental Butyl tire on cover of this issue showing, *left*, freedom from tread cracking, and, *right*, absence of weather cracking of sidewall after 25,000 miles of road wear.

Summary

By using the Lambourn abrader a concept of abrasion has been proposed that fits the performance of a wide variety of compounds. The ability of this type of machine to give varying degrees of slip and braking forces has aided in the selection of the proper conditions for abrasion studies. By using a small tread pattern on the sample wheel, laboratory results are brought into closer agreement with actual road wear tests.

The work of Schallamach and the analysis of abrasion by a needle abrader have been extended to an abrasive surface. To the considerations of compound strength and surface friction or traction has been added the consideration of dynamic hardness. The abrasion of rubber has then been related to a ratio of dynamic modulus over rupture energy. This if a compound is made dynamically softer or more conformable without a sacrifice in its resistance to rupture, a superior abrading tread will result. In simple terms, what is needed for best abrasion resistance is the softest, toughest material.

Butyl owes its comparable or superior abrasion resistance (when compared to other rubbers) to the fact that its vulcanizates are dynamically softer. The heat treatment of Butyl carbon black mixtures produces vulcanizates that are still softer in relation to their rupture energy. This is the sole advantage of such a mixing procedure.

Other polymer and compounding variables that tend to *decrease* the ratio of dynamic hardness over rupture energy will improve abrasion resistance. These changes include increasing the molecular weight of the polymer and reducing somewhat the unsaturation. A certain quantity of plasticizer to increase softness and a reduction in the state of cure have been shown to be beneficial. The latter change produced by a reduction in the amount of sulfur in the compound, which limits the extent of cross-linking, has resulted in distinctly superior tire treads.

Report on Shrinkage Tests

Tests to determine the residual shrinkage of closed-cell rubber sheets should not be conducted for less than six hours at average curing temperatures, since results tend to be erratic below that time, Rubatex Products, Inc., New York, N. Y., has reported.

Such tests were conducted on one- by 12-inch samples at 212° F. for one, three, six, and 12 hours. The highest degree of consistency was achieved with the 12-hour test. It was believed that final shrinkage had still not been obtained at that time. Rubatex assumes these facts would be apparent notwithstanding the composition of the samples.

EDITORIALS

Synthetic Rubber Producers Organization Needed

DISLOCATIONS in the rubber industry resulting from the transfer of ownership and operation of the GR-S type rubber plants from government to private industry were expected, but the extent and the degree of these dislocations at present are somewhat more than anticipated. This situation may become worse instead of better unless these producers do something soon.

The present private industry producers of GR-S type rubber, realizing earlier this year that some degree of voluntary standardization of their industry would be needed with the end of the work of the Office of Synthetic Rubber of the Federal Facilities Corp. in that field, asked the American Society for Testing Materials and its Committee D-11 on Rubber to arrange for the adoption of certain former government methods of test as ASTM standards. A new subcommittee on synthetic elastomers was formed in D-11, therefore, with representation from producers and consumers and with general-interest members included to balance the membership of the group.

Work on establishing the requested methods of test as ASTM standards is underway, but in connection with nomenclature and specifications, some difficulties that should be resolved promptly and some controversies have developed. Producers have continued to use the former government coding for the various grades of GR-S type rubber, and the ASTM will undoubtedly recommend that this practice be continued. What is needed immediately, however, is a universally acceptable procedure for coding new grades and a central office from which code numbers for new grades may be obtained promptly.

The chairman of the ASTM subcommittee on synthetic elastomers, B. S. Garvey, Jr., Sharples Chemicals Division, Pennsylvania Salt Mfg. Co., Wayne, Pa., will attempt to make provisions for assigning these new code numbers as soon as approval can be obtained from ASTM Committee D-11 and the producers for him to act in this capacity.

It seems obvious, however, that a regular organization and office to handle this procedure and many other problems of the GR-S type rubbers should be established as soon as possible. Some of the problems and decisions requiring cooperative action by these producers cannot wait the length of time necessary for action by a voluntary organization such as the ASTM.

If the GR-S type rubber producers do organize into a trade association or similar body, such an organization could be entirely independent or could become a part of the Manufacturing Chemists Association or The Rubber Manufacturers Association. The Plastic Materials Manufacturers Association decided to become a part of the MCA a few years ago.

If the synthetic rubber producers should decide to become a part of the RMA, it is suggested that the association change its name to the Rubber & Rubber Products Manufacturers Association as being more accurate and descriptive of its functions.

A controversy exists over the extent to which specifications for GR-S type synthetic rubber should be established. Producers favor end-product specifications only while consumers favor continuation of all of the former "Specifications for Government Synthetic Rubbers." In view of these and other problems that are bound to arise, it would seem wise for the synthetic rubber producers to band together in some sort of official organization as soon as possible.

R. G. Seaman

EDITOR

Meetings and Reports

Goodyear Medal Award, Technical Manpower, New Rubbers to Feature Rubber Division, ACS, Philadelphia Meeting

The meeting of the Division of Rubber Chemistry, American Chemical Society, to be held at the Bellevue-Stratford Hotel, Philadelphia, Pa., November 2-4, will be featured by a contributed paper by A. W. Davison, vice chairman of the Engineering Manpower Commission of the Engineers Joint Council, on "The Technical Manpower Situation," on the afternoon of November 2, and the Goodyear Medal Address by R. P. Dinsmore, vice president in charge of research and development, Goodyear Tire & Rubber Co., entitled, "Specifications for a Rubber Chemist," on the morning of November 3.

The Goodyear Medal Award ceremonies will take place on the evening of the same day as a part of the program of the banquet of the Rubber Division. Arthur W. Carpenter, with The B. F. Goodrich Co. from 1927 until his retirement in April, 1955, secretary of Committee D-11 on Rubber of the American Society for Testing Materials and past president of that Society, will speak on the 1955 Goodyear Medalist and his achievements. The banquet scheduled for 7:00 p.m. will be preceded by the cocktail party arranged by the suppliers to the industry.

Four half-day technical sessions will begin on the afternoon of November 2, with Division Chairman John M. Ball, Midwest Rubber Reclaiming Co., presiding at the first session, and will continue until noon on November 4. Papers to be presented at the first session will cover methods of quality evaluation, at the second session will be devoted to compounding techniques, at the third session will deal with new synthetic rubbers including the new synthetic *cis*-polyisoprenes, and at the fourth session will be of more general nature.

All the regular papers given before the technical sessions will be judged on the following basis: (1) technical importance of subject matter; (2) quality of oral presentation; and (3) quality of the visual presentation, and one paper will be selected for the "Best Paper Award" of the Division by a committee of judges appointed from the members.

The 25-Year Club luncheon meeting will be held on November 2, with A. H. Nellen, Lee Rubber & Tire Corp., as chairman for this meeting.

Registration will begin on the evening of November 1 and continue throughout the course of the meeting. Hotel reservation cards will be sent out by October 1 by the local arrangements committee headed by B. S. Garvey, Jr., Sharples Chemicals Division, Pennsylvania Salt Mfg. Co.

Each registrant for the Philadelphia meeting will receive gratis a copy of "Collected Lectures from the Philadelphia Rubber Group's Basic Technology Course," courtesy of the local rubber group.

The business meeting of the Division will be held the morning of November 3, at which time reports of various committees and the announcement of new officers and directors for 1956 will be made.

Ladies' Program

The local committee has arranged a special program for the ladies of the members and guests attending this meeting, with G. J. Wyrough, Wyrough & Loser, in charge of these activities.

Registration for the ladies will be held from 9:00 a.m. to 5:00 p.m. in the Red Room of the hotel on November 2 and 3. At 3:00 p.m. on November 2 there will be a tea and entertainment in the Burgundy Room, for which there will be no charge.

There will be a motor tour to Independence Hall and Valley Forge on November 3, leaving the Bellevue-Stratford at about 9:30 a.m., stopping for luncheon at the famous Bull Tavern, visiting Colonial Mansion in Fair Mountain Park, and returning to the hotel at about 3:00 p.m. The price for this event will be $3.15, plus the cost of the luncheon.

On November 4 there will be a coffee hour at 10:00 a.m. in the Red Room, free of charge.

A. W. Davison

A. W. Davison, who will address the Rubber Division on the afternoon of November 2, holds a B.S. degree from Denison University, an M.S. from Ohio State University, a Ph.D. from Cornell University, a D.Eng. from Rensselaer Polytechnic Institute, and a D.Sc. from Denison University.

Dr. Davison has taught chemistry at Ohio State, Cornell, the University of Cincinnati, and RPI. He was head of the department of chemical engineering at RPI. During 1949-53 he was director of research of Owen-Corning Fiberglas Corp. He has been a consulting chemist and chemical engineer since 1953 and is a member of the American Chemical Society, American Institute of Chemical Engineers, and other scientific societies.

Program and Abstracts of Papers

Wednesday Morning—November 2

9:00 a.m. Registration.

12:00 noon. 25-Year Club Luncheon Meeting. A. H. Nellen, chairman.

Wednesday Afternoon—November 2
Methods of Quality Evaluation
J. M. Ball, Presiding

2:00 p.m.—1. Introductory Remarks. J. M. Ball.

2:05 p.m.—2. Ozone Cracking of Rubber—Objective Evaluation through Creep Measurement. H. M. Leeper[1] and G. L. Gable, Monsanto Chemical Co., Nitro, W. Va.

A test for ozone resistance has been designed wherein continuous, objective, and non-destructive measurement is made of the extent of ozone cracking in elastomeric vulcanizates. The test involves measuring continuous creep of ring specimens cut from flat vulcanized sheets 0.025-0.030-inch thick. Suspended from the ring is a dead load of sufficient mass to produce an initial extension of 20%. Because of the high ratio of surface to volume of the specimen, the loss of supportive cross-sectional area accompanying ozone cracking results in appreciable lengthening of the loaded ring. Plots of ring length *vs.* exposure time provide a continuous description of the extent of ozone cracking.

The method may be used as an indoor accelerated test or in outdoor exposures. The data presented represent exclusively outdoor exposures of tire tread vulcanizates containing experimental antiozonants. The duration of the test in warm weather varies for one week for poorer antiozonant-additives to 1-2 months for the more effective additives.

The fact that the observed creep is attributable almost entirely to ozone cracking, as opposed to oxidative deterioration, is demonstrated. The degree of correlation of results with those of indoor accelerated tests and other outdoor tests is described. The effectiveness of wax as an additive is shown. The variables, state of cure, and antiozonant concentration are reported.

2:30 p.m.—3. Exposure Tests of Chlorosulfonated Polyethylene Compounds. H. A. Winkelmann, Dryden Rubber Division, Sheller Mfg. Corp., Chicago, Ill.

Colored chlorosulfonated polyethylene compounds may be made with blends of natural rubber and GR-S type styrene rubber. Low hardness compounds may be made by further addition of white oil or Carbowax[2] as extenders.

Exposure tests of these compounds have been made in Chicago, Ill., Miami, Fla.,

[1] Name in bold face indicates author presenting paper.
[2] Carbide & Carbon Chemicals Co., Union Carbide & Carbon Corp., New York, N. Y.

and under the RS sunlamp. Observations were made for color retention, chalking, crazing, and cracking with and without strain. Color changes under the RS sunlamp are much more severe than after outdoor exposure. Stabilizers and extenders may be added to the compounds that help maintain color under prolonged exposure. Chicago exposures show chalking, but this can be reduced by selection of stabilizers, fillers, and extenders. Crazing of "Hypalon"[3] compounds is observed under all exposure conditions, but can be reduced to a minimum by the elimination of clay.

Cracking of "Hypalon" blends was observed when the compounds were exposed with and without strain in Chicago and Florida. Cracking under strain can be retarded by the addition of certain stabilizers and extenders. Cracking of "Hypalon" blends exposed without strain is quite general in Chicago and Florida atmospheres. Some stabilizers and extenders eliminate this type of cracking. "Hypalon" blends of natural rubber and GR-S type styrene rubber can be made with good color retention in which the tendency toward chalking, crazing, and cracking has been reduced to a minimum or eliminated.

2:55 p.m.—4. A Study of the Effects of Gamma Radiation on Rubber Compounds and Polymers. J. W. Born, The B. F. Goodrich Co. Research Center, Brecksville, O.

During 1954 a study[4] was conducted to evaluate the resistance of rubber compounds to radiation damage, learn something of the mechanisms of rubber deterioration during nuclear irradiation, and develop ways to prevent the deterioration.

Some 200 vulcanized rubber compounds underwent gamma radiation exposures ranging from 0.1 to 70 megaroentgens, inclusive. The deterioration of the rubber compounds was evaluated by conventional stress-strain and stress-relaxation measurements. Special stress-relaxation measurements during irradiation indicated much less deterioration of rubber in vacuum than in air. Irradiation products of rubber compounds were analyzed with a mass spectrometer and an infrared spectrophotometer.

The study produced a catalog of stress-strain data for 190 rubber compounds as a function of gamma radiation dose. Among pure gum rubber compounds, natural rubber has the best radiation resistance. GR-S type styrene rubber, Hycar 1001,[5] "Hypalon" S-2, and carboxylic polyethylacrylate gum rubber compounds have good resistance. Polyisobutylene, Hycar PA-21,[5] and Thiokol ST[6] gum rubber compounds have the poorest resistance of the materials tested. The corresponding black rubber compounds showed similar variations in resistance.

Chemical additives were found which markedly inhibit radiation damage, giving at least a tenfold improvement. The half-time of continuous stress relaxation of pure gum natural rubber during irradiation is twice as long in vacuum as in air.

3:15 p.m.—5. The Technical Manpower Situation. A. W. Davison. A contributed paper.

A. W. Davison,
Engineering Manpower Commission

3:50 p.m.—6. The Effect of High Temperature on the Properties of Organic and Silicone Rubbers. G. M. Konkle, J. T. McIntyre, and J. V. Fenner, Dow Corning Corp., Midland, Mich.

The behavior of elastomers at high temperature is of increasing interest. Much data are available on the effect of heat aging in which the properties of the vulcanizates were determined at room temperature. Relatively little information is available about properties of vulcanizates aged and tested at elevated temperatures.

Hardness, tensile strength, and elongation of natural rubber and several synthetic rubbers were measured at temperatures from room to 482° F. The effect of aging at elevated temperature was combined with testing at these temperatures.

Natural rubber, GR-S type styrene rubber, Butyl, neoprene, nitrile, polyacrylic, 1,1-dihydroperfluoro butyl acrylate (Poly FBA), a copolymer of acrylic ester and acrylonitrile (Acrylon BA-12), and silicone rubbers were studied.

All rubbers tested showed a drastic reduction in strength and elongation at elevated temperatures. Some polymers show better heat resistance than natural rubber or GR-S type styrene rubber when properties were determined at room temperature after heat aging. However, these polymers are more drastically affected than natural rubber or GR-S type styrene rubber when tested at elevated temperatures.

When tensile samples are conditioned at elevated temperature only long enough to reach temperature equilibrium, the properties obtained after testing at these temperatures show natural rubber to be best up to 300° F. Above 300° F. the tensile strength and elongation of silicone rubber are superior to those of any of the other rubber compounds investigated. However, when the samples are first aged at elevated temperatures and then tested at the same elevated temperature, silicone rubber is the best of the rubbers evaluated at 250° F. or above.

4:10 p.m.—7. Compounding of Silicone Rubber, IV. Testing of Silicone Rubber at Elevated Temperature. Aldo J. DeFrancesco, Roger D. Alling, and John H. Baldrige, The Connecticut Hard Rubber Co., New Haven, Conn.

An apparatus for measuring tensile strength, elongation, and tear strength of rubber compounds at elevated temperatures was designed and constructed. The test apparatus was combined with a Scott tensile tester.[7] Emphasis was placed on simplicity of construction and on validity of comparative test results.

It is known that silicone rubber, in comparison with other rubbers, has by far the best resistance to high-temperature aging. More information with respect to the properties of silicone rubber at high temperatures is necessary.

Tensile strength, elongation and tear strength of various silicone compounds were determined at room temperature, 200, 300, and 400° F. It was found that these properties decrease markedly at elevated temperatures. A discussion of the results is presented.

4:35 p.m.—8. A Discussion of Some Factors Influencing the Duplicability of Tire Road Wear Testing. L. R. Sperberg, Three-T-Fleet, Odessa, Tex.

Many factors influence tire wear and the measurement of abrasion losses during road testing. This paper is concerned with a discussion of some of these factors.

Factors affecting abrasion resistance calculations, as reflected by methods of calculation, test methods, duplicability of measurements, and the influence of the number of test tires, are discussed.

In addition the effects of tire position on the test vehicle, the mechanical condition of test vehicles, particularly wheel alinement and balance, type and condition of roadway surface, tread profiles, atmospheric and tire temperatures, vehicle speed, tire load, trailer positions are also discussed as they influence the final calculations of tire performance.

Thursday Morning—November 3
Compounding Techniques
J. W. Snyder, Presiding

9:00 a.m.—9. Highly Stabilized Non-Discoloring Rubber Compositions. D. B. Merrifield, Monsanto.

Conventional aromatic amine anti-degradants, although superior to the relatively non-discoloring phenolics, cannot be used in white rubber or rubber adjacent to enameled surfaces because of migration, staining, and discoloration.

A non-discoloring dithioamine vulcanizing system, using a thiazole as an accelerator and a hindered hydroquinone as an anti-degradant, is described which possesses excellent resistance to heat aging and ozone attack, as well as markedly improved processing safety. Free radical mechanisms are postulated to explain some of the observed results.

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[3] Elastomers division, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

[4] This research was conducted under a contract with the Materials Laboratory of Wright Air Development Center.

[5] B. F. Goodrich Chemical Co., Cleveland, O. Hycar 1001 is a nitrile rubber. Hycar PA-21 is an acrylic rubber.

[6] Thiokol Chemical Corp., Trenton, N. J. Thiokol is a polysulfide rubber.

[7] Scott Testers, Inc., Providence, R. I.

9:25 a.m.—10. Vulcanization of Butyl with Other Rubbers. F. P. Ford and R. L. Zapp, Esso Research & Engineering Co., Linden, N. J.

The incompatibility of butyl with other rubbers, except neoprene, has long been recognized. Usually mixtures of butyl and other polymers of higher unsaturation yield porous, blistered, laminated, or cracked products when vulcanized.

Various techniques have been used to improve the compatibility of butyl with other rubbers. These include precuring and chemical modification of butyl. Other methods have more recently been found by which standard grades of butyl may apparently be vulcanized with other rubbers in any proportion. Vulcanizates of such mixtures have been prepared by two methods: (1) the addition of a lead oxide, such as PbO or PbO_2, to blends containing conventional "ultra" accelerators, (2) the use of certain specific "mild" accelerators, in the absence of an "ultra" accelerator. In the latter case, lead oxides are not desirable. Specific accelerators which are reasonably effective include butyraldehyde-aniline products, diphenylguanidine, diorthotolyl guanidine, 2-mercaptoimidazoline, triethyltrimethylenetriamine and N-cyclohexyl-2-benzothiazole sulfenamide.

Vulcanizates prepared by either of the above-mentioned methods appear to be dense, homogeneous, and free of defects usually associated with mixtures of butyl and other rubbers. Volume swell measurements in cyclohexane fail to extract rubbery material. This fact is taken as evidence that both polymers in such blends are chemically cross-linked. These vulcanizates are characterized by relatively high extension modulus, low elongation, low tensile strength, and high hysteresis. Such properties are dependent upon the proportion of butyl rubber in the blend. Tensile and elongation are at a minimum in blends containing 75 parts butyl in 100 parts total rubber hydrocarbon. In such compositions, with 50 parts of SRF black for example, tensile strengths are in the order of 1,300 psi., and elongation about 300%. Better properties are obtained with either lower or higher proportions of butyl.

Practical applications of these reactions are in the development stage. It has been shown, however, that they facilitate the preparation of harder butyl vulcanizates than has hitherto been believed possible. Semi-ebonites have been made with high sulfur loadings in butyl compounds containing minor amounts of GR-S.

9:50 a.m.—11. Sulfur Vulcanization of Vinyl Substituted Polysiloxanes. K. E. Polmanteer and R. J. Koch, Dow Corning

The principal method used for cross-linking linear polysiloxanes to produce an elastic state has been with the aid of peroxides such as benzoyl peroxide. This work describes results obtained from vulcanization studies of vinyl containing linear polysiloxanes using sulfur and accelerators as the cross-linking agents. It was found that olefinic groups such as vinyl attached to silicon were necessary to permit sulfur vulcanization in this polymeric system.

The rate of vulcanization and the ultimate state of cure were found to be dependent upon the content of vinyl groups in the polymer. Like other sulfur-vulcanizable polymers, the choice of accelerator to use with sulfur also played an important part in determining vulcanization rates in this polysiloxane system. Strong organic bases, guanidines, and thiuram disulfides are the most active accelerators in this polymeric system; while zinc oxide and organic acids inhibit and retard vulcanization.

As in the case with some organic polymers, certain accelerators such as tetramethylthiuram disulfide were found to be suitable vulcanizing agents without the aid of elemental sulfur. The temperature coefficients for rate of vulcanization ranged from 2.54 down to 1.85 per 10° C. change in temperature; while the Arrhenius activation energies for this system ranged from 31.5 down to 20.3 kilocalories per mol. Both the temperature coefficients and the activation energy values depended upon the type of accelerators present.

10:15 a.m.—12. Effect of Varying the Vulcanization Temperature on the Physical Properties of Black Reinforced Tread Compounds. J. F. Svetlik and H. E. Railsback, Phillips Petroleum Co., Bartlesville, Okla.

Recent technological developments have permitted tire manufacturers to adopt the use of shorter curing cycles at higher temperatures. Advantages accrue to the rubber tire manufacturer and customer alike because production costs are thereby reduced. However, increasing the curing temperature can alter the physical properties of rubber stocks. As the vulcanization temperature is increased and curing time is decreased to attain the same state of cure, some of the physical properties are improved, while others are deteriorated, which condition may affect performance of the finished product.

To evaluate the effect of temperature on physical properties, specimens were vulcanized for variable periods of time at 253, 280, 307, and 343° F. Typical tread-type compounds reinforced with FEF, HAF, ISAF, and SAF carbon blacks were studied to establish if the reinforcement imparted by different blacks is affected by varying the vulcanization conditions. The changes in stress-strain, hysteresis, hardness, crack growth, and abrasion resistance properties have been investigated as a function of vulcanization time and temperature.

R. P. Dinsmore,
1955 Goodyear Medalist

Compounds vulcanized at progressively higher temperatures possessed lower modulus, higher hysteresis, and lower dynamic hardness. Vulcanizates prepared at high temperature contain less free sulfur and appear to possess better crack-growth resistance. The properties imparted by the different blacks are compared, and their reaction to varying the vulcanization conditions is discussed.

10:40 a.m.—13. The Effect of Carbon Black on the Oxidation of Rubber. F. Lyon, K. A. Burgess, and C. W. Sweitzer, Columbian Carbon Co., New York.

Previous studies in this laboratory show that the oxidation reactions of unvulcanized cold rubber (LTP GR-S type styrene), as measured by oxygen absorption, intrinsic viscosity, and solubility, are inhibited by carbon black. The present study extends these investigations to the oxidation of non-sulfur GR-S type vulcanizates, to the effect of carbon black on the physical properties of heat treated unvulcanized cold rubber films, to the role of the acetone extractable fraction of GR-S on the rate of oxidation and cure of carbon black-cold rubber films, and to the effect of carbon black on the oxidation of natural rubber films.

The effect of carbon black on the oxidation of GR-S type vulcanizates was found to be dependent on the curative system. Carbon black inhibits the oxidation of dicumyl peroxide vulcanizates to the same degree as previously reported for unvulcanized rubber films. This fact is in contrast to the accelerating effect of carbon black on the oxidation of sulfur vulcanizates reported by Case Institute* and confirmed in this laboratory. In rubber as well as other polymer systems carbon black can inhibit or accelerate oxidation and polymerization reactions, depending on the other compounding ingredients present.

Static heating of unvulcanized cold rubber films at 125° C. initiates scission reactions, thereby softening the sample as indicated by the strain-time relation. If carbon black is present, however, identical heat treatment stiffens the film, indicating that carbon black not only inhibited the scission reactions, but also bonds with the polymer. The physical properties of unvulcanized films aged at room temperature show that carbon black inhibits polymer cross-linking reactions.

The effect of carbon black on the benzoyl peroxide oxidation of cold rubber is dependent on the acetone extractable fraction of the rubber; while with oxygen or air oxidation, the acetone extractable fraction plays a relatively minor role. With unextracted cold rubber, carbon black has been shown to accelerate the benzoyl peroxide gelation; while with acetone extracted rubber carbon black inhibits gelation.

The effect of carbon black loading on natural rubber oxidation is similar to that previously reported for cold rubber.

11:05 a.m.—Business Meeting.

11:20 a.m.—14. Goodyear Medal Ad-

* *Ind. Eng. Chem.*, 38, 1052 (1946).

dress—Specifications of a Rubber Chemist. R. P. Dinsmore.

Thursday Afternoon—November 3
New Synthetic Rubbers
A. E. Juve, Presiding

2:00 p.m.—15. Carboxylic Rubber. J. Green and E. F. Sverdrup. U. S. Rubber Reclaiming Co., Inc., Buffalo, N. Y.

The chief use of scrap rubber has been for the manufacture of a controlled intentional degradation product known as reclaimed rubber. To date little has been accomplished in utilizing scrap rubber as a low-cost starting material for controlled polymer synthesis. This paper discusses a carboxylic-type elastomer prepared from tire scrap, and the properties of such elastomers. Comparisons of these elastomers with the familiar polychloroprene rubbers are given.

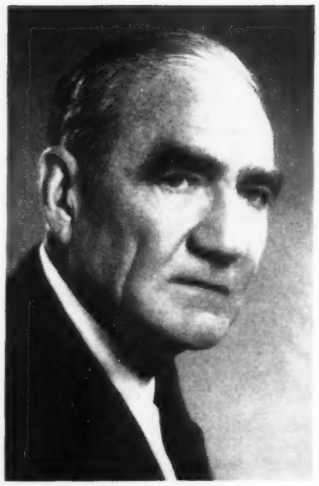
Unsaturated compounds containing an electrophilic group, such as a carboxyl group, alpha to a double bond, have been combined with natural and GR-S type vulcanized rubber scrap. The vulcanized rubber scrap is replasticized and combined with the above unsaturates in one operation. A reaction mechanism is discussed. The resulting products have Mooney viscosities (ML 212/5-1) of up to 125. Tensile strengths of up to 2,000 psi, and Shore A hardnesses of as high as 80 can be obtained on vulcanizates containing no additional reinforcing filler. The degrees of reaction and scrap used are governing factors in connection with vulcanizate properties. These self-reinforced vulcanizates have oil resistance and excellent aging properties.

Increasing the concentration of the unsaturates increases the Mooney viscosity of the uncured material and the tensile strength, modulus, durometer, and torsional hysteresis ot the revulcanized material. The benzol extract on uncured acetone extracted samples decreases with increasing concentration of unsaturates.

These carboxylic elastomers show versatility with respect to methods of vulcanization. Sulfur requirements are reduced, and excellent non-sulfur cures are obtained by the use of bivalent metal oxides as the curing agents. Other curatives are glycols, diamines, epoxy resins, and diisocyanates. The mechanism of vulcanization is discussed briefly.

The oil resistance of these carboxylic elastomers is generally equivalent, when compounded, to that of the polychloroprenes. The prospect of a "built-in" antioxidant, chemically part of the polymer, is a distinct possibility. Other properties discussed include aging, ozone resistance, compression set, use in blends with other elastomers, and the processing characteristics. These elastomers can be extended with large quantities of petroleum and or ester oils. Several applications for the carboxylic elastomers are suggested where advantage may be taken of the oil resistance, good aging, and comparatively low cost.

2:25 p.m.—16. Ameripol SN—A Synthetic *Cis*-Polyisoprene—Polymer Preparation and Properties—I. S. L. Horne, Jr., J. P. Kiehl, J. J. Shipman, V. L. Folt, Goodrich Research Center. Paper to be presented for Goodrich-Gulf Chemicals, Inc., by **F. K. Schoenfeld,** vice president, research, The B. F. Goodrich Co., Brecksville.



Ferenz Fedor

John M. Ball, Division Chairman

A rubber has been synthesized which has the same unit structure as the natural rubber hydrocarbon. Since the latter is recognized to be a *cis*-polyisoprene, the new rubber is termed a synthetic *cis*-polyisoprene. Infrared absorption spectra of the unvulcanized material and of its hydrochloride (except for minor peaks due to oxidation) and X-ray diffraction pattern of the stretched vulcanizate are identical with those of *Hevea* rubber. A sample of synthetic *cis*-polyisoprene showed the same second-order transition temperature as that of *Hevea* rubber (—68° C). The iodine number and elemental analysis check closely with values for *Hevea* rubber. Mooney viscosity (ML 4 mins. at 212° F.) is usually in the 50-75 range. Tack of the polymer is like that shown by milled *Hevea* rubber.

Intrinsic viscosities of the new rubber run as high as 4 (in toluene). Solvents in the solubility parameter range of 8.6 ± 1.35 appeared to be solvents for both synthetic *cis*-polyisoprene and for milled pale crepe *Hevea* rubber. Preliminary work on the ratio of viscosity average to number average molecular weights indicates that the molecular weight distribution of synthetic cis-polyisoprenes is somewhat comparable to that of milled *Hevea* rubber. Stabilization of the synthetic polymer can be adjusted so that its rate of oxygen uptake at 100° C. is no greater than that of *Hevea* crepe rubber.

2:40 p.m.—17. Ameripol SN—A Synthetic *Cis*-Polyisoprene — Processing and Vulcanization—II. E. A. Willson, Goodrich Research Center. Paper to be presented for Goodrich-Gulf Chemicals by **F. K. Schoenfeld.**

Synthetic *cis*-polyisoprene rubber stocks have been milled on laboratory equipment and in factory Banbury mixers. No preliminary breakdown is required when the Mooney viscosity (ML 4 mins. at 212° F.) of the polymer is in the 50-75 range. Compounding pigments are easily milled and dispersed in the rubber. Factory batch stocks processed well on calenders and in extruders, and extruded treads showed less linear shrinkage and less extrusion porosity than ordinary *Hevea* rubber treads.

The absence of non-rubber constituents in synthetic *cis*-polyisoprene, as made, leads to slow rates of cure in many accelerator systems. The addition of 1½ parts of soya lecithin and 0.075-part of triethanol amine to the ACS test recipe brings the rate of cure of the rubber, the stress strain properties, and stress relaxation values of the vulcanizates into line with those of *Hevea* rubber. Comparable physical properties result when such treated synthetic *cis*-polyisoprene replaces *Hevea* rubber in tread and carcass stocks.

2:55 p.m. — 18 —. Ameripol SN — A Synthetic *Cis*-Polyisoprene — Tire Testing—III. M. A. Reinhart and E. A. Willson, Goodrich Research Center. Paper to be presented for Goodrich-Gulf Chemicals by **F. K. Schoenfeld.**

The regular factory truck-tire evaluation procedure has been conducted on 11.00x20-12-ply rating highway express and bus tires using synthetic *cis*-polyisoprene throughout in current factory recipes.

Indoor Wheel Test

Tires were run continously on a smooth 67-inch diameter wheel in an ambient temperature of 100° F. ± 5° at a speed of 50 miles per hour under load increased by standardized increments each 24 hours. Heat build-up in the *cis*-polyisoprene rubber tires, as measured by thermocouple and by increase of air pressure in the tires, was in close agreement with results obtained on *Hevea* rubber control tires. Mileages to failure were comparable to those of the controls.

Test Truck Operation

Tires were run on test trucks in Texas under carefully regulated test conditions as to load, speed, and inflation pressure. Load was increased by standarized increments to 150% of Tire & Rim Association rated load.

The carcasses of the synthetic *cis*-polyisoprene tires were sound after 19,600 miles of operation, and, though about 35% of the tread pattern remained, they were recapped and placed in intracity bus operation.

Tread wear and independent cracking were slightly inferior to those of the *Hevea* controls, but resistance to growth of initiated tread cuts was comparable to that of the *Hevea* controls.

Mileage Contract Buses

Synthetic *cis*-polyisoprene tires have been placed in rigorous intercity bus operation where speeds may be higher than 70 miles per hour. The tires are operating entirely satisfactorily. Tread wear is as good and in some cases slightly better than that of the *Hevea* control tires. Independent tread cracking is slightly inferior to that of the controls, but the severity is not alarming. Service tests were initiated during the hot summer months, adding to the significance of the results obtained.

3:30 p.m. — 19. A. *Cis*-Polyisoprene

Having the Molecular Structural Features of *Hevea* Rubber. F. W. Stavely, chemical and physical research laboratories, The Firestone Tire & Rubber Co., Akron, O.

Coral rubber is a polyisoprene elastomer having chemical composition, X-ray crystalline pattern, and polymer structure very similar to those of natural *Hevea* rubber. This Coral rubber is characterized by high gum tensile values (up to 3000 psi.) and low hysteresis with good retention of properties at elevated temperature. It is superior to cold rubber (LTPGR-S type) in these characteristics.

Coral rubber is a *cis*-1,4 polyisoprene containing up to 93% of *cis*-1,4, 6.1% of 3,4 and no *trans*-1,4 or 1,2 structure. Our recent results show natural *Hevea* rubber to be 97.8% *cis*-1,4 with 2.2% 3,4 structure, and balata to be 98.7% *trans*-1,4 with 1.3% 3,4 structure. Analyses by ozonolysis and perbenzoic acid procedures appear to support these findings.

The data obtained appear to confirm that high *cis*-1,4 head to tail structure is a desirable feature in attaining those properties which are characteristic of natural rubber.

Coral rubber differs from natural rubber in that the vulcanizates exhibit better resistance to cracking and have better thermal stability than natural rubber vulcanizates. In the unvulcanized state Coral rubber is more sensitive to light.

From a technology standpoint Coral rubber is compatible in all proportions with natural rubber and with GR-S type synthetic rubbers. Processing characteristics, rate of cure, and other properties require minor compounding adjustments.

4:00 p.m. — 20. Kel-F[8] Elastomer — Properties and Applications. M. E. Conroy, F. J. Honn, L. E. Robb, and **D. R. Wolf,** M. W. Kellogg Co., Jersey City, N. J.

The development of this new fluorocarbon rubber was announced in June, 1954, and discussed in a series of papers presented before the Rubber Division[9] in New York in September of that year.

This paper reviews the basic gum properties and the recent findings on the compounding and vulcanization of peroxide and polyamine stocks. The use and effect of various fillers in these compounds are also described. The physical, thermal, and chemical properties of these vlucanizates are discussed.

The various methods of fabrication are outlined including the extrusion of tubing and wire insulation. The results of the most recent functional testing of Kel-F Elastomer mechanical goods are also presented.

4:25 p.m. — 21. Polyacrylic Ether-Ester Elastomers. — I. The Compounding and Properties of Vyram[10] Polyacrylic Elastomer. C. L. Gable, **H. W. Kilbourne,** P. E. McIntyre, M. J. Pugh, Monsanto, St. Louis, Mo.

Compounding and physical properties are discussed for a new polyacrylic ether-ester elastomer marketed under the trade mark of Vyram. Vulcanizates of the product exhibit outstanding resistance to swell by a wide range of solvents and industrial functional fluids. As a result of increasingly stringent performance requirements, lubricants and functional fluids used in modern aircraft and industrial equipment have become more diversified, and no single fluid is likely to meet all requirements.

It has become quite difficult to provide elastomeric compositions for sealants and packings which will resist the petroleum-base, phosphate ester, chlorinated hydrocarbon, and dibasic acid ester fluids. Vyram acrylic elastomer exhibits excellent resistance to all these fluids, and it may be used for service at temperatures in the range of 10-250° F. Several potential end-uses, including hydraulic seals and packings, are suggested.

5:00 p.m. — Suppliers Cocktail Party.

7:00 p.m. — Banquet — Goodyear Medal Presentation.

Friday Morning — November 4
General Papers
B. S. Garvey, Jr., Presiding

9:00 a.m. — 22. Control of Polymer Breakdown in Oil-Polymer Masterbatches. W. K. Taft, J. Duke, T. B. Larchar, Sr., W. G. Kitzmiller, M. Feldon, University of Akron, Government Laboratories, Akron, O.

The induction period that an oil-masterbatched polymer undergoes prior to its breaking down during aging at 140° F. in an oven seems to be related to the amount of iron required in the polymerization formula. The rate of breakdown can be controlled by adjusting the iron content in the polymerization charges, but the amount of breakdown with the highly aromatic oils was not controlled to the extent sufficient completely to stabilize the polymers. The amount, time, and rate of gel formation were affected also by the amount of iron in the charge.

That the iron is involved has been shown by adding iron to "iron-free" latices to cause breakdowns similar to that obtained with polymers prepared according to a "high iron" formula. Polymers made from charges containing fatty acid soap have been shown to be less stable than those from charges containing rosin acid soaps.

The iron in a polymer made according to a "high iron" formula can be chelated with a suitable agent to prolong the stability of the polymer with and without oil and reduce markedly, but not eliminate except for polymers masterbatched with a highly paraffinic oil, the rate of breakdown and decrease the tendency of the polymer to gel.

Coagulation of latices with a zinc salt reduced the tendency of the subsequent polymers to break down, and aluminum sulfate was more effective in this respect.

9:25 a.m. — 23. Correlation of Polymer Breakdown with Absorbency Index. W. K. Taft, **J. Duke,** D. Prem, A. D. Snyder, University of Akron, Government Laboratories.

The ultra-violet absorbencies of ten oils used for oil-polymer masterbatching, where plotted against their concentration in solution with n-heptane or 85/15 methylcyclohexane/ethanol, were found to obey Beer's law. When the absorbency indices are plotted against the wave length, a peak at 260 mμ seems to be indicative of the aromatic reactivity of the oils.

Plotting the rate of polymer breakdown in oil-polymer masterbatches against the absorbency index of the oils yields a graphical pattern that can be represented by two straight lines of different slopes. With some polymers, breakdown was found to be directly related to the "aromaticity" of the oil in the masterbatch as shown by ultra-violet absorption at 260 mμ.

In other cases there was an acceleration in breakdown apparently directly related to the reactivity of the nitrogen bases and indirectly related to the paraffin content. This added acceleration may depend upon the state of oxidation of iron present, since ferrous iron and not ferric iron seems to accelerate the rate of polymer breakdown induced by nitrogen bases. Evidently certain mixed soaps keep the iron in the ferrous condition and subsequently influence the breakdown of a polymer.

9:50 a.m. — 24. A Glass Polymerization Vessel for Small-Scale Laboratory Studies. J. D. Sutherland and J. P. McKenzie, Copolymer Rubber & Chemical Corp., Baton Rouge, La.

There has been a need of a small-scale glass polymerizer for laboratory work in the synthetic rubber industry. During the Reconstruction Finance Corp. program considerable work was done at Goodyear Tire & Rubber Co., using pint mason jars as reaction vessels. This type of reactor has many drawbacks which have been overcome in the reactor developed in this laboratory. The essential features of the newly designed unit follow:

1. The glass vessel is a half-inch thick Pyrex globe which is available as standard equipment as a globe for explosionproof lighting fixtures. It will hold a half gallon of material and is capable of withstanding high internal pressures.

2. The agitator is a hydraulically driven marine-type impeller. The seal mechanism in the oil motor acts as a positive seal for the agitator shaft.

3. The reactor contains an internal cooling coil which eliminates heat transfer problems at all reaction temperatures.

4. It has a stainless steel lid which has a vent, a sample line, thermal well, and a screw cap which contains a self-sealing gasket.

This type of reactor has been found very useful in studying emulsion polymerizations over a wide range of temperatures. It is particularly useful for studying high solids latex systems in which agitation and heat transfer problems are aggravated because of the viscous nature of the latex.

It is of convenient size for use with high-cost monomers. Only a minimum quantity of such monomers is required, and sufficient finished product can be prepared for small-scale laboratory testing.

10:10 a.m. — 25. Thermal Degradation of Vulcanized and Unvulcanized Rubber

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[8] Kel-F is the M. W. Kellogg Co.'s registered trade mark for its fluorocarbon polymers.

[9] RUBBER WORLD, Aug., 1954, pp. 661, 662.

[10] Registered trade mark of Monsanto Chemical Co., which supersedes the code number, N-5400.

in a Vacuum. S. Straus and S. L. Madorsky, National Bureau of Standards, Washington, D. C.

Samples of a high grade of pale crepe rubber, unvulcanized, and also vulcanized in the presence of various vulcanizing ingredients and carbon black, were pyrolyzed in a vacuum at around 370° C. A qualitative and quantitative analysis of the light volatile fractions were carried out in the mass spectrometer, and a material balance of all volatile and non-volatile fractions was made. The characteristic volatile fractions, one volatile at —80° C., and the other volatile at room temperature, consisted mainly of the monomer and dimer, respectively. Vulcanized rubber gave substantially less yield of these volatiles than did the uncured rubber.

Rates of thermal degradation of unvulcanized and vulcanized rubber samples were studied in the temperature range 305-325° C. The vulcanized samples were found to degrade at a rate which was on the average 55% higher than for unvulcanized rubber. The activation energies for all rubbers were in the range 56-65 kcal. It is concluded, on the basis of this investigation, that any cross-linking which might have been produced in the rubber by sulfur vulcanization becomes ineffective at the temperature of pyrolysis.

10:50 a.m.—26. Determination of Degree of Cure in Filler Reinforced Vulcanizates by the Swelling Method. Gerard Kraus, Phillips Petroleum.

The Flory-Rehner theory of swelling allows an estimate of the number of cross-links in gum vulcanizates. In reinforced rubbers the apparent degree of cross-linking is raised by some fillers, particularly carbon blacks. Some investigators have ascribed this point, as well as the related increase in equilibrium modulus, to adsorption of the polymer chains at the filler surface. This interpretation raises the question whether filler contributed linkages should be included in the "degree of cure" of a vulcanizate or whether these constitute an essentially separate reinforcement effect.

It is shown experimentally that at fixed filler loading all physical properties of the vulcanizate are simple functions of the apparent number of network chains as determined from swelling equilibria, regardless of the possible origin of the linkages. Furthermore, aside from controlling the number of apparent linkages, sulfur and accelerator levels as well as cure time have only minor, secondary effects on vulcanizate properties. Comparison of swelling data of gum and black stocks shows that the apparent contribution of the carbon black to cross-linking increases with the level of cure. Softeners and extender oils cause a reduction in the number of linkages, presumably by reducing the efficiency of sulfur utilization.

Results of experiments with various carbon blacks at several loadings suggest strongly that adsorption cannot quantitatively account for the entire apparent black contribution to cross-linking. The evidence points to a combination of effects, including one due to carbon black "structure" and an influence of the black on the efficiency of the vulcanization reaction.

11:20 a.m.—27. Mixing Studies of Zinc Oxide in a Banbury. H. O. Jones and E. G. Snyder, The New Jersey Zinc Co. (of Pa.), Palmerton, Pa.

A laboratory-scale Banbury mixer operated under controlled conditions has served as a satisfactory tool in evaluating the mixing properties of several zinc oxides in rubber. The total power consumed during mixing was measured with an integrating watt-hour meter; while the instantaneous power requirements were recorded by an autographic watt-meter. Other determinations consisted of the measurement of the temperature developed in the batch, position of the ram during various stages of the mixing cycle, and the plasticity of the resultant mixing.

The investigation has included the examination of a densified zinc oxide. In a pelleted form, the zinc oxide has a substantially lower volume per unit weight, occupies a smaller volume in the internal mixer, and thereby enables a greater Banbury output. A combination of surface treatment and densification of the oxide makes possible lower power consumption and better dispersion together with the bulking advantages indicated.

A large number of mixes was based on 70-30 zinc oxide-rubber masterbatches in order to bring out pigment characteristics usually minimized in laboratory-scale mixes with normal loadings of zinc oxide. The polymers evaluated were GR-S type styrene rubber, smoked sheets, butyl, butadiene-acrylonitrile, and neoprene rubbers.

Special N. Y. Group Meeting for Wilson and Pinto

A special meeting of the New York Rubber Group has been planned for Friday, November 18, at the Henry Hudson Hotel, New York, N. Y., to pay tribute to B. B. Wilson, of RUBBER WORLD, and Peter P. Pinto, of *Rubber Age*, who have alternated as secretary-treasurer of the Group since 1936 and who are both retiring as officers of that organization at the end of the current year. Mr. Pinto was secretary-treasurer of the Group prior to 1936, having served in 1932 and 1933. Mr. Pinto is also retiring as general manager of *Rubber Age* at the end of 1955.

The dinner-meeting will be preceded by a cocktail party, courtesy of the New York Group, and the dinner program will include brief remarks by present and past chairmen of the Group who have been associated with Wilson and Pinto in the work of the local group. An entertainment program will conclude the affair.

The New York Rubber Group wishes to extend an invitation to the many friends of both men to attend this special meeting. The committee in charge is headed by M. E. Lerner, *Rubber Age*, and includes R. G. Seaman, RUBBER WORLD; J. S. Corrigall, R. T. Vanderbilt Co.; M. R. Buffington, Lea Fabrics, Inc.; and Joseph Breckley, Titanium Pigment Corp.

Reservations and tickets for this special meeting may be obtained at $6.00 each from either M. E. Lerner, *Rubber Age*, 101 W. 31st St., New York 1, N. Y., or R. G. Seaman, RUBBER WORLD, 386 Fourth Ave., New York 16, N. Y.

Rheological Meeting Set

The Society of Rheology will hold its annual meeting at the Henry Hudson Hotel, New York, N. Y., November 2-4, with 20 papers scheduled for presentation on a wide range of pertinent subjects, including four to be given Friday morning, November 4, on the rheology of polymeric materials.

Discussions on the plasticity of metals, flow phenomena in geological studies, hypoelasticity, and determination of dispersion structure by viscometry will compose the remainder of the agenda. Programs and further deails may be obtained from F. D. Dexter, Bakelite Co., Bound Brook, N. J.

Speakers and the titles of their papers for the November 4 session include Thor L. Smith, Jet Propulsion Lab, "Viscoelastic Behavior of Polyisobutylene under Constant Rates of Elongation"; Bryce Maxwell, Princeton University, "Investigation of Dynamic Mechanical Properties of Polymethyl Methacrylate"; J. E. McKinney and R. S. Marvin, National Bureau of Standards, "An Apparatus for Measurement of Dynamic Bulk Modulus"; and W. Philippoff and Frederick H. Gaskins, Franklin Institute, "Viscosity Measurements on Molten Polyethylene."

Philadelphia Group Outing

The Philadelphia Rubber Group's annual summer outing was held at the Manufacturer's Golf & Country Club, Oreland, Pa., August 19, with 260 members and guests present at dinner and 140 participating in the golf tournament at the Oak Terrace Golf Club, Ambler, Pa. Other athletic activities were cancelled because of wet grounds.

Top golfer of the day was Wes Curtis, Naugatuck Chemical Division, who became the first winner of the newly donated Muehlstein Trophy with his low gross score. Second low gross honors were divided between John Baymiller, Armstrong Cork Co., and a Mr. Basilone, a guest. The highest gross was achieved by John Berg, Alco Oil & Chemical Corp., with Bill Wade, Acme-Hamilton Mfg. Co., following closely.

Prizes to golf winners, as well as to all other attendees, were contributed by local suppliers and manufacturers. Lee White, Walker Bros., was outing chairman, and was assisted by Tom Elkins, R. T. Vanderbilt Co., Inc.; R. B. Carroll, R. E. Carroll, Inc.; George Brannan, Columbian Carbon Co.; and Henry Remsberg, Carlisle Tire & Rubber Division. The prize committee consisted of A. L. Shaw, The B. F. Goodrich Co., and Tom Elkins, The golf tournament was arranged by Tom Loser, Wyrough & Loser.

Details of Akron Symposium on Textiles and the Rubber Industry—II[1]

Questions and Answers

Q. What is the future of glass fibers in the rubber industry?

A. Smith. Glass fibers are of interest to the rubber industry because of their high strength to weight ratio and retention of properties at elevated temperatures. Interfilament abrasion of the fiber is poor; it has low shear strength and poor impact resistance. Types of glass fiber now available are being used in hose and belts for specific services at elevated temperatures, as a reinforcement for silicone rubber products and in certain industrial tapes. Development of glass fibers that correct the weaknesses now present must be effected before there will be any general use as textile material in rubber products.

Q. Do you see a future for glass fiber in tires?

A. Drew. It is deficient in flexibility, fatigue, and abrasion. Tires made of glass fiber have successfully operated for short distances, but gave fatigue failures at so low a mileage that they are considered impractical for normal tire uses.

Q. Is pretreating all types of fabric by dipping, or other means, necessary to obtain best performance in rubber products?

A. Reeves. That depends on the end-use. If the fabric does not undergo a lot of flexing and strain, then the only problem is making the rubber stick to the fabric. An open-weave cotton fabric for a non-dynamic application would not require pretreatment. Synthetic fabrics all require some treatment to obtain satisfactory adhesion for even non-dynamic uses.

Q. Are chemical, mechanical, or combination bonds responsible for adhesion between rubber and textiles?

A. Reeves. The bonding problem is quite complex and involves several materials and processes which are interdependent. The calendering operation squeezes the rubber coat through the fabric so that the cords are completely surrounded. This mechanical bonding is probably the most important factor in good adhesion between rubber and fabric. If a synthetic fabric is so closely woven that little or no "strike through" can be obtained, it is necessary to resort to the chemical covalent bonding provided by the isocyanates.

As for the dip itself, the resorcinol-formaldehyde component seems to furnish a rather constant part of the adhesion. RF is well known as an excellent adhesive by itself for other purposes. RF alone, however, is a hard, brittle material. The latex component acts as a plasticizer and carrier to provide a flexibilized adhesive.

One possible explanation for the superior adhesion provided by vinyl pyridine latex dips over and above the effect of the RF is hydrogen bonding. In the case of rayon, the hydrogen bonding could take place between the ring nitrogen of the pyridine and the hydroxyl groups of the cellulosic chain. With nylon, the bonding is probably between the ring nitrogen and the amide group of the nylon molecule. Hydrogen bonding may also take place between the hydroxyl groups of the resorcinol-formaldehyde and the ring nitrogen of the pyridine.

Q. Has any experimentation been done on the treating of the yarn or cord with an adhesive so that the consumer could eliminate the dipping process?

A. Baker. Yes, but the results thus far have not been too encouraging for tires. Some real progress has been made in mechanical goods, but better adhesive qualities are needed for tires than have yet been found. We certainly are not planning to give up on this problem.

Q. How does the asbestos fiber compare with cotton, rayon, or nylon for strength?

A. Hagen. We don't think of asbestos in terms of high tensile strength as the fiber is so extremely fine and brittle and contains so much short fiber that it is blended with cotton to spin into yarn. Actually, however, asbestos is a strong fiber, but it varies from 18,000 to 469,000 psi., with an average around 70,000 psi., and compares with 65,000-103,000 psi. for nylon, 59,000-124,000 psi. for cotton, and 35,000-90,000 psi. for viscose rayon.

Q. What is the effect of halogen-containing polymers on textiles such as rayon and nylon?

A. Smith. Halogen-containing elastomers can damage rayon and other fibers, if conditions are severe enough, so that the halogen becomes detached from the polymer. Halogen acceptors used in the compound can generally produce adequate protection of the textile. Magnesium oxide is typical of an inorganic halogen acceptor, and phenyl-beta naphthylamine is representative of organic acceptors. Under conditions of extreme weathering, for example, there is less tendering of the underlying fabric if heavier coatings of the halogenated polymer are used (0.088-0.010-inch thickness) than when lighter coats (0.001-0.003-inch) are applied.

Q. What are the best conditions for ply and cable twisting and weaving of nylon? Temperature? Is there a practical method for setting or removing life of cable and twisted yarn to prevent poor and uneven weave?

A. Grew. In the ply twisting operation the best conditions seem to be 60% relative humidity and 82-85° F. In the cabling operation for woven fabrics the same humidity and temperature conditions are used. In the actual weaving operation the humidity should be 68-70%, and the temperature 84° F. After the ply twisting operation, to assure the best conditions for subsequent processes, relaxing time should be about 24 hours, and after the cabling operation the material should also be allowed to relax for 24 hours.

In an effort to minimize poor or uneven weaving the twisted yarn or cable yarn should be conditioned on the twister bobbins 1-2 hours, depending on the degree of twist, at 140° F. wet bulb, 150° F. dry bulb, and after conditioning should be allowed to relax for 24 hours. In the case of the filling, the yarns on filling bobbins should be conditioned for 25 minutes at 130° F. wet bulb, 140° F. dry bulb, and allowed to relax for 24 hours before further processing.

Q. How much of a part does interfilament abrasion play in tire cord fatigue? Will use of a lubricating-type finish materially improve "in rubber" fatigue life?

A. Baker. Interfilament abrasion is a big factor in cord fatigue. A rayon filament as such will withstand millions of severe flexures before it will fail owing to internal fatigue. This test is equivalent to hundreds of thousands of miles of driving. In a tire, movement of filaments within the structure of the cord is essential to prevent stiffness and brittleness. At any hinge point in the tire this movement is localized and intensified and may result in premature failure unless there is adequate lubrication or some other protection.

Some feel that filaments can be sufficiently protected by deep penetration of dip, thus insulating them from each other. This belief may be true, but we feel that residual lubrication after curing is more important in this case. This lubrication is a function of the finish which the rayon producers apply, and it does affect fatigue life materially.

Q. What kind of fabric is used in the Indianapolis racing tires?

A. Kersker. Firestone uses nylon fabric in these racing tires to obtain the maximum safety and high speed performance. Nylon makes possible a lighter tire which is up to 90% stronger and cooler running.

Q. What are the problems with rayon, nylon, and other synthetics in baggy fabric?

A. Drew. Baggy fabric in the tire industry is fabric which varies in warp length across the width of the fabric. This variation may occur in the center or on either or both edges. Baggy fabric causes processing difficulty wherever the fabric must be led over rolls because the shorter portions tend to run out of line and fold over, causing wrinkles which can result in a great deal of scrap fabric. Baggy fabric can be caused by uneven tensions in the cord as it is twisted or woven. It can be caused because of moisture variation in storage, improper handling during adhesive treatment, uneven pressure at the calender, and moisture variations due to storage conditions between calendering and cutting. It can be present in any type of natural or synthetic cloth.

Careful control of all steps of manu-

[1] Concluded from our Sept. '55 issue.

facture are required to reduce this problem. Uniform twisting and weaving tensions must be maintained in the fabric cord. Uniform moisture conditions must be maintained during all stages of the processing, especially for rayon. Uniform temperature conditions must be maintained during processing in thermoplastic fibers such as nylon.

Q. What progress is being made by the yarn suppliers to reduce the shrinkage of super-tenacity rayon tire cord that takes place during the dipping and the drying operation?

A. Peterson. Rayon research personnel are quite conscious of the problems created by wet contraction of high-tenacity yarns, but have been able to make little progress in overcoming this condition. As the strength and fatigue resistance have been improved, wet contraction has increased. High-tenacity cords have been made with lower wet contraction, but such cords have been deficient in some other important properties such as growth or fatigue. When the growth is high, then it is necessary in the dipping operation to apply sufficient tension to stretch the cord and thereby reduce growth. The tension required in this case is equivalent to that necessary with conventional super-tenacity rayon to prevent wet contraction. Thus such a low-wet contraction, high-growth yarn offers no advantage to the tire company. Samples with both low-wet contraction and low growth have been prepared, but have been deficient in fatigue. I know of no solution to the wet contraction problem at present.

Q. Discuss the possibility of nylon replacing rayon in tires. Will it replace in passenger or truck tires first? What are the relative economics? What will be the rate of conversion? Will there be adequate nylon capacity?

A. Peterson. I believe the probability is high that nylon will replace rayon as the dominant tire yarn. It has already essentially taken over the airplane tire and the off-the-road truck tire markets and is rapidly taking over the heavy-duty truck and bus tire business. In the case of the very heavy truck tires, nylon already affords lower initial tire cost than rayon. As for the large-volume over-the-road truck tires, where nylon still commands a premium price, the cost-conscious truckers are building up impressive and carefully recorded facts to demonstrate the increased utility per dollar offered by nylon tires.

In the replacement passenger-tire field, the premium nylon tires are demonstrating that when the service is rough; the greater margin of safety they provide is worth a substantial premium. Police, who must run their squad cars at high speeds on turnpikes, truckers, who follow their construction trucks in a passenger car, ordinary drivers in some of our states where the roads are rugged, and Southwesterners, who travel for hours at high speeds on hot roads, are demanding nylon today because through experience, they have proved to their own satisfaction that nylon tires are worth a premium.

As for the economics involved, I have already mentioned that some nylon truck tires cost less today than similarly rated rayon tires. Let us consider the four-ply passenger tire, in which nylon today has an economic handicap. To discuss the economics in detail, I would have to be much better versed in the elements of tire costs than I am. But undoubtedly, the main cost variable involved is the cost of the yarn per tire. So, if we assume that one pound of nylon replaces 1.6 pounds of rayon and costs approximately 2.25 times as much, then the cost of yarn per tire is 40% higher for nylon than for rayon. It is expected that the nylon passenger tire will continue to be a premium tire in price as well as in quality.

As for the rate of conversion, I do not feel qualified to make an adequate prediction.

Now the final question. At this time there is an adequate supply to meet the demand. We expect to meet the growing demand placed on us by the industry, but in order to do so, we must have adequate advance notice of any marked acceleration of the swing to nylon tires.

A. Baker. There is certainly a possibility that in the future some fiber may replace rayon in tires, but we do not now recognize this as a probability. We know that there are limited applications where some prefer nylon to rayon, but with all the apparent increases in these uses the volume of nylon still represents only 10% of the total used in 1954.

On the present basis actual figures from tire builders indicate that fabric for passenger tires will run 60 to 75% higher in cost when made from nylon than when rayon is used. The difference is not so great in truck and bus sizes, but is appreciable. These extra costs must be passed on to the consumer, as in premium tires, or be absorbed by the tire producers. Justification in either case can be questioned. We do not feel that sufficient data have been accumulated to show that nylon actually out-performs rayon from the standpoint of tire life and returns. We do feel that rayon is making a tire comparable in performance at much lower average cost. After all, the objective is to give a satisfactory product at the lowest cost.

It is true that the use of rayon dropped during the last year or so, but this decline was almost entirely due to conditions which arose within the tire industry. These losses can roughly be attributed to the following: inventory reductions, 30,000,000 pounds; drop in truck tire production, 27,000,000 pounds; drop in passenger-tire production, 15,000,000 pounds; drop in production of other types of tire and items, 15,000,000 pounds; and increase in use of nylon, 16,000,000 pounds. We look for heavier usage of all types of fabrics in tires. This is due to improved market conditions, but there should be little or no change in the percentage figures for 1954.

Q. What are the optimum conditions for processing nylon tire cord?

A. Peterson. Let me describe what our Du Pont research laboratories consider the best conditions. The heart of the tire cord processing is hot stretching, which paves the way for controlling growth in the tire, reducing the amount of nylon per tire, and minimizing flat-spotting. The most important variables in hot stretching nylon cord are temperature, time, percentage of stretch, and method of handling the cord after stretching. Hot stretching is carried out to reduce both inflation growth and long-term creep and to stabilize the cord against thermal shrinkage. Within certain limits the higher the percentage of stretch, the higher the temperature, and the greater the time in the stretching zone, the lower will be the growth.

With the conventional type of adhesive dip, increases in temperature and time must be limited because of yarn degradation that leads to appreciable tenacity loss, but if an adhesive dip containing an antioxidant is used, a temperature as high as 410° F. for 120 seconds can be used. Under these conditions cord stretched 22% will give a 20% reduction in growth and a 15% increase in tenacity of the cord properties obtained via more conventional hot stretching conditions. In addition, the higher the temperature and time, the more the cord is stabilized against thermal shrinkage.

From a fundamental viewpoint the nylon physical structure is modified by correct stretching to yield the best possible crystal structure and molecular orientation, and by proper heat treatment this structure is given a somewhat permanent set. Nylon cords processed in this manner will lead to a reduction in the amount of nylon per tire and will give tread wear at least equivalent to that obtained with the rayon tire.

Since hot stretched nylon cords gradually undergo relaxation after hot stretching their growth increases between the time they are hot stretched and the time they are incorporated in the tire. Here the ingenuity of the tire production team in maintaining the maximum tension on the cords after hot stretching, and minimizing the interval between hot stretching and tire building should pay good dividends in providing greater utility of the nylon in the tire.

Finally, such tire building techniques as expansion into the mold and cooling of the mold while the tire is still under pressure, when combined with the cord processing steps, lead to the highest level of cord properties in the tire.

Q. Is nylon Type 6 equivalent to nylon Type 66 in tires?

A. Drew. Well over 99% of the American nylon tire experience is with Type 66 nylon, and there is too little experience with Type 6 to make positive statements. We should make it clear that the nylon Type 66 is the normal Du Pont and/or Chemstrand produced material polymerized from adipic acid hexamethylenediamine. The Type 6 nylon is the Perlon or caprolactam polymer. Since the Type 6 has a lower melting point which results in a lower softening point, it is questionable whether it will be equivalent to the 66 nylon in service. It may, however, give a good account of itself where heat is not a major factor. It can also be said that at least some of the nylon Type 6 cords lack the fatigue resistance of the Type 66.

The processing characteristics of these two nylon types are quite similar. Type 6 seems a little easier to stretch, but

harder to stabilize. It is generally believed that the amount of heat experienced in service will be the major factor in determining which type of nylon will be successful, and since the present use of nylon in premium tires results in their being used in the most severe type of service, Type 66 remains the most desirable type at present.

Q. What is the status of synthetic fibers such as Dacron, nylon, rayon, and X-36 in belts?

A. Smith. Rayon and nylon are recognized as textile materials for belts. Nylon, however, does not have the proper characteristics for use as a sole tension member in flat belts. Dacron, a comparative newcomer, is now established as a textile material in fire hose jackets, V-belts, and some top grades of flat belting. X-36, now known as Fortisan 36, is available in limited quantities and is being used in certain V-belts and hose where its properties can be used to advantage.

Q. What causes tire cords to fail under normal operating conditions?

A. Baker. Overall, the percentage of premature failures is extremely low. This question seems to imply that premature failure is due either to faulty construction or to excessively abusive use. Certain road hazards will cause failures no matter what materials may have been used in tire construction. The most prevalent cause of premature failures can be traced to imperfections in individual tires, arising from various sources.

Q. What causes flat-spotting of nylon tires?

A. Peterson. When a tire is run, its temperature and inflation pressure increase. At the elevated temperature and pressure, the cords undergo a slight creep or extension. When the car is stopped, the cords located at the point where the tire contacts the ground are under less tension than the cords in the remainder of the tire. The warm cords under the reduced tension relax or shrink, thereby giving rise to a flat-spot. These flat-spots run out upon driving. Such variables as modulus of the rubber and angle of the cord in the reinforcing fabric are also pertinent factors.

The flat-spotting problem is not considered a serious one since it can be controlled by proper heat treatment of the cord to reduce both creep and thermal shrinkage. Some of the early nylon tires showed excessive flat-spotting, but today nylon cord tires are being made that show no more flat-spotting than do rayon cord tires.

Q. Does nylon tire cord retain moisture to the same extent as rayon tire cord, and is there much danger of moisture pick-up after coating?

A. Drew. Since rayon fibers normally contain 10-11% moisture, and nylon fibers 3-4% moisture under normal atmospheric conditions, and since rayon is plasticized by moisture, while nylon is plasticized by heat, rayon is more affected by moisture than nylon. When rayon or nylon is used in tires, the moisture content of both must be carefully controlled during processing if production with uniform cord tensions is to be expected. Each type of cord will pick up moisture after coating. This moisture pick-up will result in non-uniformity, which will then cause processing difficulties.

Q. Why should not the heat-setting treatment required for nylon be the responsibility of the yarn supplier rather than the responsibility of the tire producer?

A. Peterson. Extensive research on nylon has failed to uncover the technology required to permit the yarn supplier to relieve the tire producer of the need of hot stretching and has shown it improbable that hot stretching by the tire producer can ever be circumvented as long as nylon is used. If nylon were hot stretched by the yarn producer, it would be of no avail, since as soon as the tire producer dipped and dried his tire fabric, the nylon cord under the high drying temperature would relax, losing most of the advantage gained through stretching unless high tension were maintained on the cord. If the high tension is required anyway, then the tire yarn can be conveniently hot stretched at this time.

An additional reason for the tire producer carrying out the hot stretching is that nylon cord slowly relaxes after this treatment, making it necessary that the time interval between hot stretching and tire building be as short as possible if the maximum utility of the stretching operation is to be realized.

It is true, however, that considerable activity is under way to improve the properties of nylon tire yarn as supplied by the yarn producer. Currently, experimental samples of an improved yarn are being evaluated by the tire companies.

Q. What is the status of combination yarn fabrics for the rubber industry?

A. Grew. Belting fabrics made with cotton warps and filament yarn filling are being used in increasing volume for conveyor belting. Combination yarn fabrics are also being used to some extent for breakers and cure-wraps.

Q. What are the principal factors upon which the maximum obtainable fabric strength depends?

A. Hagen. Fiber selection, weight of fabric, size of cords, amount of twist, and fabric crimp.

Q. How does the size of the cords affect the fabric strength?

A. Hagen. The larger the cord, the lower the tensile efficiency of the fiber. Large cords in the filling also increase fabric crimp, which further reduces the obtainable tensile strength.

Q. How does the twist affect the tensile strength?

A. Hagen. There is an optimum twist for spun yarns beyond which the tensile strength decreases. For filament yarns the strength begins to decrease immediately twist is inserted. Some fibers are more sensitive to twist than others, but high twist reduces the strength of all yarns and fabrics.

Q. To what extent has the Beta-ray gage proved successful in measuring square yard weights in the rubber industry?

A. Smith. The investment in Beta-ray gages can be justified in the savings produced due to better weight and gage control.

In general, units which show poorest uniformity without such controls show the greatest gains from such devices.

Q. Is the textile industry experimenting with finer filament yarns and lower denier cords made from super-tenacity rayon yarns?

A. Baker. Yes. Much work is being done along this line. The finer filaments pose quite a manufacturing problem for rayon producers as the physical quality may suffer with decreases in filament size. The smaller the filament, the more susceptible it is to mechanical damage. As to lower denier cords, this is more of a problem of economics. Machine production is curtailed with each drop in denier; so our problem is to overcome this handicap within our plants without the necessity of too great an increase in the price of the fabric to you.

Quite a bit of progress has been made, but the fabric is not yet ready for the market in any quantity to support a commercial run.

Q. What can be done to avoid fabric shrinkage?

A. Hagen. Fabric shrinkage depends to a large extent on the fiber content. Some fabrics can be stabilized by heat; others can be stabilized by resins or preshrinking processes.

Q. What are the advantages of spun nylon fabrics for rubber reinforcement?

A. Grew. Fabrics made from 100% nylon staple have found a place in the diaphragm and flexible tubing field. They have good resistance to flexing and can be rubberized without the necessity of predipping.

Q. Can you tell us something about the role of fungicides in textiles for the rubber industry?

A. Smith. Properly selected fungicides impart improved life to those products exposed to conditions where attack by fungi causes premature failure. An effective fungicide must also be checked for its effect on aging, vulcanization, adhesion, odor, and toxicity.

Q. What is the best method of obtaining good cured adhesion of nylon cord fabric to natural rubber carcass stock?

A. Reeves. With good calendering and the following dip formula: vinyl pyridine latex, 100; resorcinol, 11; formaldehyde, 6; and caustic soda, 0.3. Make up the resin solution at 6½% solids, reacting it for six hours at 75-78° F. Dilute latex with enough water to make a 20% solids dip. Add RF solution and mix. The dip may be used immediately, or allowed to age. There is no effect on final calendered cord adhesion either way. The life of the dip depends on temperature. In extremely hot weather, it may start to cream in 24 hours. In cool weather it has been known to last three weeks.

More Rubber Courses Set

Akron Group Series Begins

A series of ten lectures on rubber compounding is currently under way at the evening division of the University of Akron under the sponsorship of the Akron Rubber Group. The course, supervised by C. E. Carlson, The General Tire & Rubber Co., is designed essentially for non-technical personnel in sales, purchasing, marketing, production, and allied fields.

The series began October 3 and will continue on Monday evenings from 8:15 to 10:15 p.m. until December 12. Lecturers and their subjects follow:

October 3, Mr. Carlson, "Introduction"; October 10, O. D. Cole, The Firestone Tire & Rubber Co., "Natural Rubber"; October 17, I. D. Patterson, The Goodyear Tire & Rubber Co., "Synthetic Rubber"; October 24, John M. Ball, Midwest Rubber Reclaiming Co., "Reclaimed Rubber, Its Manufacture, Properties, and Uses"; November 7, Walter Vogt, Goodyear, "Introduction to Rubber Compounding."

Also, November 14, A. E. Juve, The B. F. Goodrich Co. Research Center, "Physical Testing"; November 21, Lee Oneacre, Cooper Tire & Rubber Co., "Vulcanization"; November 28, C. A. Ritchie, The B. F. Goodrich Co., "Processing"; December 5, W. D. Parrish, B. F. Goodrich Chemical Co., "Special-Purpose Synthetic Rubbers—Oil Resistant Types"; and December 12, W. A. Wiard, Dow Corning Corp., "Special-Purpose Synthetic Rubbers—Heat Resistant Types."

Chicago Group Basic Study

A Basic Course in Rubber Compounding will be given at John Marshall Law School, Chicago, Ill., beginning October 4, under the sponsorship of the Chicago Rubber Group. The course, to be limited to the first 50 applicants, will consist of a weekly series of 24 lectures, ending March 27, 1956, during which the compounding of natural and synthetic rubbers, as well as such materials as silicones and polyacrylates, will be dealt with. This is the Group's fourth annual sponsorship of the course.

A textbook, said to be the only piece of literature of its type in the field, will be provided each enrolled student. Diplomas will be distributed to qualifying students at the completion of the course.

Harold Stark, Dryden Rubber Division, is coordinator of the series. Several visits to rubber plants are included on the agenda.

Registrants should address John C. Gallagher, c/o Chicago Allis Mfg. Corp., 113 N. Green St., Chicago 7, Ill.

Tlargi Classes Begin

Classes in rubber technology at the University of Southern California, sponsored by The Los Angeles Rubber Group's Rubber Technology Foundation, have begun and will continue throughout the fall semester.

The courses, providing students with credit toward a university degree, are designated Rubber Technology II and III, taught by Harry L. Fisher, director of the Foundation; and Rubber Technology Laboratory I, taught by Joseph B. Larkin and Dr. Fisher. In addition a non-credit Basic Rubber Technology course, providing practical instruction in the manufacture, sale, and chemistry of rubber goods, is being given, with Laurence E. Peterson, The Goodyear Tire & Rubber Co., as instructor.

Further information may be obtained from Tlargi Rubber Technology Foundation, 920 W. 36th Place, Los Angeles 7, Calif.

Boston Rubber Group Series

Two courses in rubber technology and one in rubber chemistry have been scheduled for the fall and spring sessions at Northeastern University, Boston, Mass., under the sponsorship of the Boston Rubber Group.

Rubber Technology I, a basic and practical study of compounding and processing of natural and synthetic rubbers, designed for salesmen, purchasing agents, production supervisors, and others requiring fundamental knowledge of the subject, will be given for 15 weeks beginning September 28. Richard E. Gross, Simplex Wire & Cable Co., is the instructor.

Rubber Technology II, a more detailed study of the theories and concepts of rubber chemistry and technology, including such subjects as polymerization, vulcanization, and reinforcement, will begin in February, 1956, and will continue throughout the spring term. B. B. S. T. Boontra, Godrey L. Cabot Research Laboratories, is the instructor.

Outline of Rubber Chemistry I, a basic but intensive study of the subject, will be given from September 28, 1955, to January 25, 1956. Further details on these courses and registration information may be obtained from the University.

Akron Polymer Lectures

The ninth season of lectures offered by the Akron Polymer Lecture Group at the University of Akron has begun. H. Mark, Brooklyn Polytechnic Institute, spoke on "Synthesis and Properties of Crystallizable Polyolefines," September 16; and C. S. Marvel, University of Illinois, spoke on "New Polymerizable Monomers Containing Nitrogen and Sulfur," October 17. The lectures are given in Room 107 of the University's Knight Hall at 8:00 p.m. Program chairman of the Group is N. V. Seeger, The Goodyear Tire & Rubber Co.

The announced schedule of forthcoming lectures follows:

November 4, L. H. Cragg, McMaster University, "Dilute Solution Viscosity."

December 2, W. R. Smith, Godfrey L. Cabot, Inc., "Some Recent Aspects of Reinforcement."

January 6, 1956, R. C. Osthoff, General Electric Co., "Polymerization of Organosiloxanes."

February 3, E. E. Hardy, Mobay Chemical Co., "Polyurethanes, A New Plastic Technology."

March 2, W. O. Baker, Bell Telephone Co., "Polymer Carbon."

April 13, H. G. Cassidy, Yale University, "Preparation and Properties of Electron Exchange (Redox) Polymers."

RIRC Rubber Plans

The Rhode Island Rubber Club is sponsoring an advanced rubber chemistry course at the University of Rhode Island under the instructorship of Robert C. Kohrn, supervisor of new product development, United States Rubber Co. To begin September 21, the course will consist of 15 classes, each two hours long, to be held every Wednesday at 7:00 p.m. Tuition for the entire course is $20.

According to the Rhode Island Rubber Club, the course will include a review of organic chemistry nomenclature, structural formulae, polymerization, and other pertinent reactions; followed by a study of the chemical structure, preparation, vulcanization, and properties of natural rubber, GR-S, neoprene, nitrile, Butyl, polyurethane, and other elastomers. The nature of a number of plastics will also be dealt with.

Application blanks or further details should be obtained from the University of Rhode Island, Division of University Extension, 25 Park St., Providence 8, R. I.

British Polymer Symposium

A symposium on the properties and applications of flame-resistant polymers will be held at the National College of Rubber Technology, London, England, November 23 and 24, under the sponsorship of the English technical publication, *The Rubber & Plastics Age*.

Seven lectures on the subject have been scheduled, with an eighth to be announced. Speakers and their topics follow: W. S. J. Skinner, British Geon, "PVC and Related Polymers"; J. Gadsby, ICI plastics division, "PTFE and PTFCE"; F. Tattersall, Proban, "Flame-Proofing of Textiles"; H. E. Parker, ICI general chemicals division, "Chlorinated Rubber"; J. R. Phillips, Dunlop Rubber Co., and J. R. Scott, RABRM, "Flame-Resistant Rubber"; H. J. Lanning, Durham Raw Materials, "Neoprene"; and C. P. Vale, B.I.P. Chemicals, "Thermosetting Resins."

Chairman of the conclave is Sir Hugh Linstead, chairman of the Parliamentary & Scientific Committee.

Further details may be obtained from *The Rubber & Plastics Age*, 147 Grosvenor Rd., Westminster, London, S.W. 1, England.

Cleveland Nuclear Meeting Scheduled December 12-16

A Nuclear Engineering & Science Congress will be held in Cleveland, O., December 12-16, and will feature the presentation of 300 papers on nuclear developments, according to Engineers Joint Council, New York, N. Y., coordi-

(*Continued on page 130*)

NEWS of the MONTH

Washington Report and National News Summary

. . . The special commission on rubber research of the National Science Foundation considered four plans for future use of the Government Rubber Laboratory at Akron, O., and what to do about government financing of basic research on rubber after July 1, 1956, at its meeting in Washington on September 29. The commission has been asked to report to NSF Director Alan T. Waterman by mid-November so that its report and NSF comments may be forwarded to Congress and the White House early in January.

. . . Negotiations with bidders for the Institute, W. Va., GR-S plant are scheduled to begin October 8, and indications are that more than a few bids have been entered for this plant.

. . . A federal judge in Washington has granted the tire manufacturing industry a permanent injunction against the Federal Trade Commission's quantity-limit discount rule on replacement tire sales of December, 1951. FTC Chairman Gwynne is reported as considering a review of the situation to decide whether to appeal the decision in a higher court.

. . . Commerce Department reports on business indicators for the rubber industry suggest 1955 production and sales of rubber products will establish all-time records. New rubber consumption of 1,440,000 long tons in 1955, another new record, is also predicted.

. . . Tariff cuts on rubber-soled footwear granted Japan recently will stand, but no further cuts on this type of product will be considered since it is not on the list of items to be discussed by the United States and 25 members of the General Agreement on Tariffs and Trade organization in Geneva, Switzerland, in January. Some other rubber products, however, appear on this list.

. . . A general wage increase of 12¢ an hour has been granted United Rubber Workers, CIO, employes in the plants of Firestone Tire & Rubber Co., B. F. Goodrich Co., and Goodyear Tire & Rubber Co.

. . . Price increases on airplane tires and tubes, mechanical goods, and soles and heels were announced by several companies in September.

Washington Report

By ARTHUR J. KRAFT

Rubber Research Commission Report to NSF Now Due Mid-November

National Science Foundation Director Alan T. Waterman has pushed forward to mid-November the deadline for his special 11-member commission on rubber research[1] to come through with recommendations on the future role of the government in supporting basic research in synthetic rubber and on whether to dispose of the $2-million government rubber laboratory and pilot plant at Akron.[2]

Time for NSF Comments Required

Original deadline for the blue-ribbon special commission's report was December 31, but Dr. Waterman, in announcing the new date at the commission's first meeting here September 29, explained that an advancing of the deadline was desired by the board of directors of NSF to permit them to look over, and prepare comments upon, the commission's findings and recommendations at the board's regular December meeting.

This procedure does not mean, NSF officials explained, that the special commission's proposals stand in danger of being sidetracked or even modified by the NSF directors. The proposals will go forward to the President and to Congress in the form desired by the commission members themselves. NSF, however, as the government agency charged by Congress with the task of evaluating the future role of the government in basic rubber research, cannot delegate its responsibility to a group of expert outsiders, although it can—and will—rely on such a group, the 11-member special commission of scientists, business and legal experts, to do the evaluating.

The special commission was asked at its organizational meeting to have at least a rough draft of its report ready within 45 days. The NSF directorate is expected to prepare its own comments on the report, to be submitted as a covering letter to Congress and the White House in early January.

Akron Laboratory Disposal Plans

The sharp contraction in working time for the commission has been offset somewhat by thorough preliminary work conducted in its behalf by NSF staff experts.

[1] RUBBER WORLD, Sept., 1955, p. 770.
[2] *Ibid.*, July through Dec., 1953; May and June, 1954.

For instance, the commission at its initial meeting September 29 had before it an outline staff memorandum dealing with alternative approaches to disposing of the Akron Government Laboratory facilities.

Rather than striking out blindly in the dark, the commission has been provided with a rundown of the major disposal plans and the arguments for and against each alternative approach. In addition, the staff brought together data on the Akron Laboratory and the factors which must be considered in evaluating disposal choices. As an example, it has not been known whether the Laboratory—with 40% of its business historically done on behalf of the Defense Department—could attract enough business from private sources to operate without government subsidy.

It goes without saying that some measure of the demand for the Laboratory's services is a prerequisite to an intelligent decision on whether and to whom to turn over the facilities—indeed, as to whether the Laboratory can be sold, at all. To help get a line on the likely demand for Akron Laboratory's services from private industry, NSF this summer authorized the present contract operator, the University of Akron, to try to sign up two large research projects for private companies, using a schedule of fees and costs designed to reflect a profit. What success the University meets in drumming up bids on these two authorized prospects of profitable operation will serve as a guide to the commission as to a future private owner of the Akron Laboratory.

At least four approaches are being explored by the commission. These are: (1) sale to the highest bidder, more or less under the standards used in disposing of the synthetic rubber producing plants earlier this year; (2) sale or lease to a nonprofit organization, such as the University of Akron, with a proviso giving first priority to developmental and testing needs of the Defense Department; (3) a lease-sale to a private, industry-wide research foundation; (4) continued government ownership and operation.

Plan 1 seems best suited to obtaining the highest financial return through disposal and has the additional attraction of conforming with the "clean break" philosophy of government from business of the Eisenhower Administration, the same philosophy which guided sale of the 25 rubber producing facilities. But it is contingent on a demonstrable prospect of adequate demand within private industry for utilization of the Laboratory's facilities. It poses a danger of narrowing competition between small and large rubber companies, in the event the Akron Laboratory falls under the control of a large firm. This plan also leaves up in the air the question of how the Defense Department will meet its needs for testing work on new rubbers.

Plan 2 overcomes many of the objections to an outright sale to a high bidder, but it promises little, if any, financial return to the taxpayer. It may prove attractive in the event that NSF surveys indicate little demand for the Laboratory's services from the rubber industry, so little that the government would be faced with a choice of shutting down the Laboratory or keeping it open—for the Defense Department and whatever private business can be had—as a subsidized operation. While these conditions would equally point to continued government operation (also subsidized), the Administration, and perhaps private business, too, would prefer seeing the Laboratory in private hands, with a minimum of government control.

Plan 3 is perhaps the most novel and would require some fast moving by the rubber industry, and perhaps others, to effect. It would require the establishment of an industry-wide, industry-supported research foundation, either restricted to rubber manufacturers or encompassing rubber, the high polymers, and plastics as well.

The first idea could be developed if the rubber companies showed strong interest in collective, industry-wide research —something which at the moment these companies, keyed to a high degree of competitive research, do not favor

The latter suggestion, a broad-based research foundation covering all types of elastomer materials, again would depend, to a somewhat lesser degree, on the participation of the rubber companies. Its major drawback, however, appears to be the substantial expenditures that would be required to equip the Laboratory and pilot plant for developing and testing the many additional types of materials which the plastics industry produces.

Plan 4, retention of the Laboratory and pilot plant by the government, as already noted, presupposes a lukewarm demand for the Laboratory's services on the part of private industry. Like Plan 2, it offers attractions to smaller rubber fabricators who could call upon the Laboratory for research work. It also offers perhaps the best protection to the present interests of the Defense Department.

However, finding a federal agency to run the Laboratory may be a troublesome problem. NSF, with know-how in basic research and experience in contract work, is barred by its Congressional charter from operating laboratory facilities. The Defense Department is not well geared to handling contract work for private clients. The National Bureau of Standards has its own laboratories and pilot plant and probably could not fully utilize a large rubber research facility that duplicates, to some extent, its own research facilities. NBS, too, is staffed by civilians hired under and subject to the Civil Service system and its complex of rules that make for perhaps too high degree of rigidity in work assignments for adaptation to the demands of private industry clients.

Contract Research

Another problem with which the commission is coming to grips is whether the government should continue to finance basic rubber research at universities and private laboratories. This financing is now done under contracts, totaling nearly $1 million a year, granted by the Office of Synthetic Rubber, Federal Facilities Corp., and its predecessor synthetic rubber producing agencies, in previous years, and taken over by NSF for the current year. The money for this work came out of government earnings from the sale of synthetic rubber (this year, from the receipts of the sale of the rubber producing plants).

The contracts, which run for one year from July, 1955, to July, 1956, and were approved by *ad hoc* advisory committee panel on synthetic rubber of OSR, are listed below. The amount of money provided for each project for the fiscal year 1956 is indicated first, and amounts provided for fiscal years 1955 and 1954 follow in parentheses.

Akron University, $50,000 management fee for operating Akron Laboratory and pilot plant for the government.

Burke Research Co., Van Dyke, Mich., for work toward improving synthetic rubber for use in heavy-duty tires. Project involves research on improving elastomers and improving the reinforcing agents. Grant, $150,000. (Fiscal year 1955 was $150,000; FY-54 was $170,000.)

Case Institute of Technology, for investigation of fundamental physico-chemical properties of synthetic latices and polymer substitutes; development of methods for studying such systems; and development of instruments to improve the study and evaluation of such systems. $70,000. ($70,000, $90,000.)

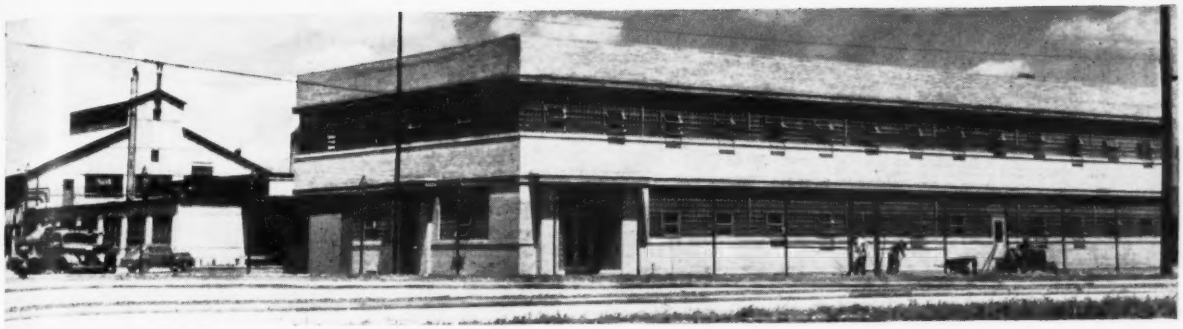
University of Chicago, for determination of mechanism of the scission on carbon-carbon bonds by light and oxygen in presence of additives. It has been shown that it is possible to alter completely the nature of products formed in a given free radical reaction using so-called "free radical trappers" which stabilize the free radicals.

It is proposed to extend their use to the polymerization and copolymerization of monomers. It appears that important improvements in properties of a copolymer can be effected to yield a polymer of high intrinsic viscosity. An attempt will be made to introduce directly certain functional groups into preformed polymer molecules and to condense these groups with appropriate bifunctional compounds.

Project also includes development of methods for stabilization of monomers in the vapor stage and in storage, and continuation of basic research on free radical mechanisms of reaction. $55,000. ($55,000, $69,000.)

Cornell University, for determination of molecular structure of polymers in their different physical forms and the relation of such structures to overall mechanical or electrical properties. Various types of polymers will be subjected to measurement of their osmotic pressure, heat of fusion, viscosity, light scattering, rate of crystallization, stress-strain-temperature studies, dielectric frequency effects, field induced diffraction, etc.

It is anticipated that these studies will lead to knowledge of molecular weight and molecular weight distribution of polymers and will provide fundamental data on which to base necessary theories of polymerization and properties of polymers. $68,000. ($70,000, $79,000.)



Government Laboratory at Akron, O.

Cornell University (separate grant). Immediate aim of this project is to elucidate stepwise the mechanism of transformations through which natural rubber is synthesized in latex-bearing plants. The ultimate aim is to uncover new ideas that may be developed into novel approaches to making synthetic rubber by methods fundamentally different from those now in use.

An organic chemist and a plant physiologist are to conduct this research jointly. Postulated intermediates and rubber precursors, tagged with radio-carbon, are tested on latex-producing plants to determine whether or not they are concerned in the biosynthesis of rubber. Various possible isoprenoid intermediates will be synthesized which contain carbon-14 and their fate in latex-producing plants will be established. $20,000. ($30,00, $33,000.)

University of Illinois, for the preparation of new polymers which may meet needs of the Defense Department, such as, polymers with low hysteresis values needed in large truck tires and that are stable at high temperatures. Also project directed at seeking knowledge on the relation between structures of polymers and their properties.

Synthesis of thermostable polymers will be attempted using chelate complexes of phenolic Schiff bases containing divalent metal ions of zinc, copper, nickel, and iron.

Encouraging results have been obtained in synthesis of copolymers from butadiene and analogs of benzal acetophenone which show low heat build-up. These leads will be followed actively. Other new polymers will be prepared which may possess oil-resistant properties.

Physical chemical investigation will be directed to obtaining knowledge of properties of macromolecules in solution with particular reference to dimensions (sizes and shapes) of polymers and physical interactions between polymer molecules. An understanding of these subjects should aid in designing the best possible elastomers. $135,000. ($120,000, $140,000.)

Mellon Institute of Industrial Research, University of Pittsburgh. The project concerns the relation between various aspects of structure and the physical properties of synthetic rubber.

The study will include: (1) development and application of methods for determining structure of synthetic elastomers: (a) X-ray and birefringence studies of crystallinity and orientation in synthetic elastomers; (b) determination of molecular weights and dimensions by osmometry, light scattering, and viscometry for analytical purposes and for estimating degree of branching; (2) development and application of methods for investigating physical properties of polymers: (a) study of low-frequency dynamic behavior of solid polymers with the major objective of assessing effect of structure on molecular weight, extent of cross-linking, fillers, etc., on dynamic loss factor (this is closely related to heat build-up); (b) rheological investigations of polymers and their concentrated solutions to understand better fundamental properties underlying processing characteristics and industrial physical tests; (c) study of tensile strength and stress-strain properties of elastomers including investigation of mechanism of breaking and the role of cross-linking, orientation, and crystallization. $109,000. ($100,000, $115,000.)

Massachusetts Institute of Technology. Project involves the Alfin polymerization process. Catalyst consists of metalated hydrocarbon; the metal is sodium or potassium.

To be studied will be new methods for metalation, simplifying the preparation of catalysts. Also, the effects of associated salts upon reactions induced by sodium and sodium reagents, the changes in type of polymer caused by changes in composition of catalysts, and investigation of the catalysts and condition for preparing Alfin polymers which can be handled by present compounding methods (for the first six months, Godfrey L. Cabot, Inc., will have a subcontract to study and determine if Alfin polymers can be handled successfully by industry if proper care is given to details. This will demonstrate the possibility of industrial application). $105,000. ($85,000, $86,000.)

University of Minnesota. It is still not known why variations in polymerization technique affect the quality of the product. Thus, the kind and amount of shaking and preshaking before polymerization have a marked influence on the polymer produced, but the reason for this is not understood. It is not known why different hydroperoxides cause greatly different rates of polymerization; nor is the effect of addition of "boosters" during polymerization understood.

Studies will be made on the kinetics and mechanism of emulsion polymerization which may lead to understanding of these and other effects. They will include (1) effect of kind and amount of hydroperoxide on polymerization; (2) modification of polymerization by means of high molecular weight mercaptans; (3) mechanism of action of retarders; (4) role of persulfate in polymerization. $80,000. ($80,000, $90,000.)

National Bureau of Standards, United States Department of Commerce. This project includes (1) determination of fundamental physical and chemical properties of synthetic rubbers and related elastomers and of monomers and other materials used in their manufacture; (2) development and improvement of test methods for evaluating synthetic rubbers and for correlating properties with structure (using infrared and ultra-violet spectroscopy analysis). Improved physical methods will be developed for evaluating and characterizing rubber; (3) development of basic information on power loss and operating temperatures of tires to aid in the design of better synthetic rubber tires. Object of this program is to design tires with minimum amount of generated heat (heat build-up). $194,000.

How Much Future Government Research?

The major difference of opinion is whether, if the government terminates these research grants, private industry will find the incentive to continue conducting basic research aimed at similar goals. The chief goal—to which about $500,000 is dedicated this year alone under the university research program—is developing a synthetic rubber suitable for an all-synthetic truck tire. The Defense Department wants such a tire for military vehicles, and wants it very much. It would like to be rid of dependence on the natural rubber stockpile—a costly investment which costs millions of dollars each year to store and keep fresh. The military services also have special needs of rubbers which can withstand steadily increasing extremes of high and low temperatures, particularly for jet aircraft components.

The rubber industry's answer to all this is direct and unequivocal: more progress toward the all-synthetic truck tire will come from private research, stimulated by competition, than from government programs. The industry also is aware of the military's needs of special rubbers and is ready to devote all the necessary effort toward solving them. The Rubber Disposal Commission took a different view on this latter point in its report to Congress last

January. It had heavy doubts that private industry would find developing these special high- and low-temperature rubbers a worthwhile investment of its research funds and therefore lacked incentive to work on these problems.

Institute GR-S Plant Negotiations Begin October 7

Uncle Sam's super-salesmen of synthetic rubber plants wound up their summer vacations last month and braced themselves for some more hard negotiations with bidders who want "in" on the rubber producing business. With 25 war-built government plants already passed over to private ownership this year, the three-member Rubber Producing Facilities Disposal Commission was gearing last month to sell the last of the GR-S synthetic rubber plants in government hands.

Rested from earlier labors, the Commission and its top staff aides dropped in for an inspection visit September 21 at the giant GR-S copolymer plant at Institute—near Charleston—W. Va. The plant was formally advertised for bid in August, under legislation enacted in the waning days of the last Congressional session. With bids due by midnight, October 7, the Commission will have the following 75 days for negotiating a sales contract with one of the prospective purchasers. It may, under the law, wind up negotiations any time within that 75-day period, which begins October 8.

Inquiries from companies interested in buying the plant indicate that more than a few bids will be entered for the Institute facility, which has been in standby (mothballed) the past two years. The Dutch-controlled Imperial Commodities Corp. already has announced plans to bid. Rumor has it that inquiries regarding possible purchase also have come from California industrialist Edwin Pauley; American Resinous Chemicals Corp. and perhaps other small firms had entered unsuccessful bids for the Baytown, Tex., GR-S plant; General Tire & Rubber Co.; and one of the "Big Four" (believed to be United States Rubber Co.).

In all likelihood, the Commission will withhold public announcement of the names of the bidders until it reports to Congress on the results of the negotiations in January. This has been its practice in connection with previous sales of 24 plants early this year, and the Baytown plant and tank-cars sales in more recent months. If Institute is sold, the only plant of the war-built synthetic rubber industry remaining under government ownership will be the alcohol butadiene plant at Louisville, Ky. This has been reactivated by Publicker Industries, Inc., Philadelphia, under a three-year lease with the government.

FTC Tire Quantity-Discount Limit Rule Invalidated

The government's effort to place an arbitrary limit on discounts granted by tire manufacturers on their sales to the replacement market suffered what may be a deathblow last month. On September 7, in Federal District Court for the District of Columbia, Judge Alexander Holtzoff invalidated the Federal Trade Commission's quantity-discount rule. The rule had been embroiled in almost continuous legal controversy since it was first issued by FTC in December, 1951. Though originally scheduled to go into effect in April, 1952, the rule was never applied, as a result of temporary injunctions issued by the courts during the preliminary bouts of litigation.

Permanent Injunction Granted Industry

The rule, the first (and, so far, the only) effort to implement the 20-year-old quantity-limit proviso of the Robinson-Patman Act, was issued after FTC found that the discount schedules used by tire manufacturers discriminated unfairly against smaller purchasers of tires, chiefly independent tire dealer establishments, and gave large-quantity buyers—principally oil companies and mass distributor chain-store operators—an unfair competitive advantage on tire prices. Judge Holtzoff struck down the last rule on the ground that FTC failed to make the proper findings of discrimination to support imposition of the rule. He granted a motion by the 20 plaintiff firms —mostly tire manufacturers—for a permanent injunction and a declaratory judgment invalidating the quantity-limit rule.

As issued by FTC nearly four years ago, the rule would have prohibited special discounts on account of quantity on purchases of more than a 20,000-pound carload of replacement tires and tubes bought and delivered at one time. A carload of passenger-car tires is the equivalent of about an $11,000 order. Under the rule a purchaser who bought more than this quantity would have been permitted only the customary discount available to all purchasers of a 20,000-pound carload. The discount would have applied only to the first 20,000 pounds of his order; no discount would have been allowed on the tires in the same shipment over and beyond the first 20,000 pounds.

Limit of 20,000-Pound Carload Too Low

The rule was attacked in the industry suits on several grounds, but Judge Holtzoff upset the FTC rule on only one of these and did not, in his decision, take up the other objections. In finding that FTC had not made the proper findings required by the Robinson-Patman Act to support its rule, he noted that the FTC findings were related to discriminatory discounts to purchasers who bought more than $600,000 of tires and tubes within a year. FTC found, after secret investigation, that there were too few tire purchasers in a position to buy $600,000 or more of tires in a year —and thereby receive the heftier price discount available to large-volume buyers —to make for a competitive situation. Only $^{2}/_{10}$ of 1% of the tire purchasers—63 of some 50,000—fell in this bracket, FTC said, and therefore discounts on purchases of more than $600,000 annually were unjustly discriminatory and tending to promote monopoly among dealers.

FTC, however, instead of issuing a rule limiting manufacturer discounts to the $600,000-a-year dollar volume of purchases, invoked a limit based on the quantity of tires bought and delivered as a single order and shipment. In using the 20,000-pound carload as its limit, FTC was far wide of an equivalent of a $600,000-a-year volume. Judge Holtzoff said that the findings based on the competitive situation resulting from annual dollar volume discounts on purchases of $600,000 a year could not support a quantity limit of a single 20,000-pound carload.

FTC Chairman Gwynne was reported in late September as preparing to review the situation with his fellow commissioners and staff attorneys to decide whether to ask the Justice Department to seek reversal of Judge Holtzoff's decision in a higher court.

FTC Agreement with Sock-Lining Firms

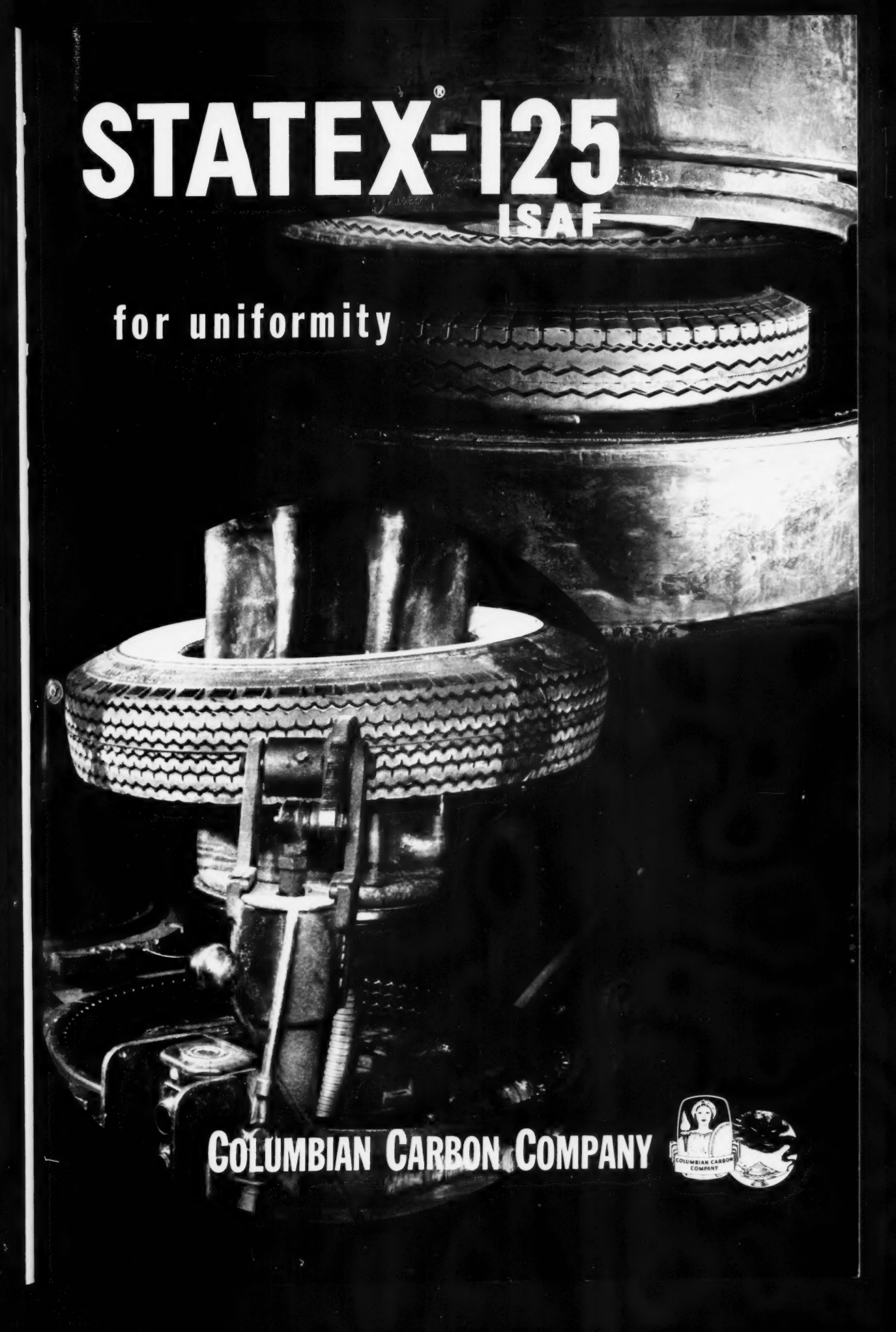
FTC has approved separate stipulated agreements with two Massachusetts manufacturers of sock-lining material whereby the two firms will not advertise or otherwise represent that their products have a leather base. The companies are Stedfast Rubber Co., Inc., Mattapan, Mass., and its subsidiary, Brookside Mfg., Inc., Boston, makers of "Brookleathar"; and Harvard Coated Products, Inc., Boston, maker of "Kidko."

Both products, sold chiefly to shoe manufacturers in 100-yard rolls, have a paper base containing a small percentage of pulverized leather, impregnated on one side with a latex compound and embossed to resemble kid leather, FTC said in announcing the stipulated agreements. "Brookleathar," the stipulation disclosed, is advertised as "a scientific chemical blending of a high percentage of leather fibers." "Kidko" is described by its manufacturer as a "Leather Base Sock Lining" (and) "Constructed with a Leather Base."

The stipulations provide that these products will not be represented as containing a leather base or as composed of a substantial part of leather or leather particles. Both firms also agreed not to use their trade names, "Brookleathar" and "Kidko," or other words suggestive of leather, unless they clearly disclose to prospective customers that the products are not leather. These stipulations are for settlement purposes only, FTC explained, and do not constitute an admission by the parties that they have violated the law.

Frank C. Ogden New ODM Materials Chief

Frank C. Ogden, a Detroit utility executive, took over on October 1 as materials chief for the Office of Defense Mobilization. On loan from the Detroit Edison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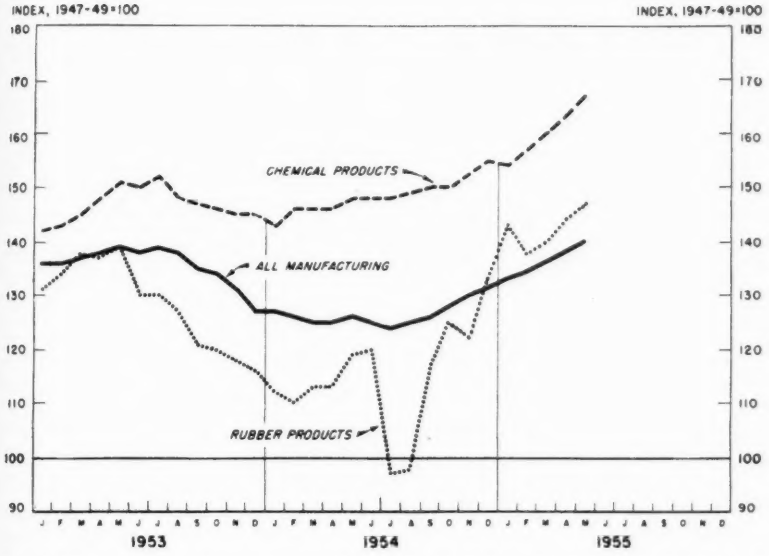
Co. where he is manager of purchases and real estate, Mr. Ogden, in his new post, will be the top adviser to ODM Director Arthur S. Flemming on the quantity of materials required to meet the nation's defense and stockpile needs, as well as on materials expansion and procurement programs for mobilization. He succeeds William S. Floyd, who has returned to Shell Oil Co.

Mr. Ogden is a past president of the National Association of Purchasing Agents and a member of the Engineering Society of Detroit and of the ODM Executive Reserve. As Assistant Director of ODM for Materials, he will assume direct supervision of the current review of the natural rubber stockpile program, a review aimed specifically at reevaluating the adequacy of present stockpile objectives in the light of latest military strategy concepts. ODM expects to complete its survey of this subject late this year when it receives up-to-date estimates of wartime military requirements for tires and other rubber products from the Defense Department.

Two rubber company officials, John L. Collyer, of Goodrich, and Thomas Robins, Jr., of Hewitt-Robins, have urged ODM to lower the stockpile objective and to authorize sale to commercial users of several hundred thousand tons of natural rubber already in the government's defense stockpile. Action on such proposals will hinge largely on the outcome of the stockpile review, ODM points out.

Commerce Department Reports on Industry Business Indicators



Federal Reserve Board monthly production indices for all manufacturing, chemical products, and rubber products industries, 1953-1955 (Adjusted for Seasonal Variation). (Source of data: monthly issues of the "Survey of Current Business," United States Department of Commerce)

The Commerce Department's Business & Defense Administration forecast during September that new rubber consumption may hit a peak of 1,440,000 long tons in 1955, a 7% increase over the previous 1953 record level.

"The ratio of synthetic rubber usage to total new rubber consumption has risen considerably so far this year, as compared to last year, largely as a result of increased natural rubber prices. This is expected," BDSA said, "to culminate in record synthetic rubber usage in 1955."

Other rubber industry business indicators noted by the BDSA Chemical & Rubber Division include:

Synthetic rubber production is headed for a 900,000-ton plus total this year.

Exports of synthetic rubber in the first half of 1955 alone have topped annual levels for previous years, except for the 1944-46 end-of-war period when natural rubber from the Far East was just getting back into trade channels. This year will be a banner year for U. S. exports of synthetic rubber.

FRB Production Index Up

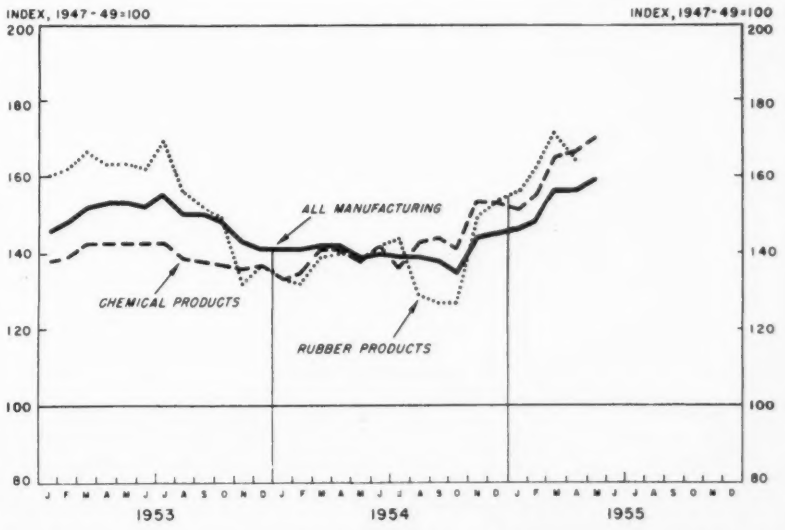
The Federal Reserve Board's monthly production index for rubber products (adjusted for seasonal variation) reached a new high of 147 in May, 1955, as against 144 in the previous month and 139 in May, 1953, the pre-1955 peak (see accompanying chart). This new high coincided with a record high of 140 for all manufacturing and demonstrated again the influence of heavy automotive product output with its demand for original equipment tires, foam rubber cushions, mats, V-belts, moldings, and dozens of other items furnished by the rubber products manufacturing industry.

The FRB production index for rubber products will fall between 138 and 142 for 1955, it was said. The FRB index was 115 for 1954 and hit a peak of 128 in 1953.

Manufacturers' Sales

Rubber goods manufacturers' sales in 1955 will exceed the 1953 record volume of $5,097 million, it was predicted.

In the first four months of 1955, sales of rubber products manufacturers totaled $1,789 million, some $9 million more than in the same period of the peak year 1953. Sales of $475 million reported for March, 1955, exceeded the previous high mark of $461 million registered in March, 1953.



Trend of monthly sales for all manufacturing, chemical products, and rubber products industries, 1953-1955. (Source: index constructed from data in monthly issues of the "Survey of Current Business," United States Department of Commerce)

Inventories of rubber products manufacturers at the end of April, 1955, on a seasonally adjusted basis, were valued at $784 million, well below the April 30 levels calculated for the three previous years. The inventory-sales ratio at the end of April, 1955, was 1.75. During most of the 1952-54 period the ratio of inventory to sales was better than 2 to 1.

BDSA also commented that the smaller number of production workers in the rubber products industry in 1955, as compared with previous years, indicates a marked increase in productivity.

Previous comment from this government agency on the growth of the number of rubber products manufacturing establishments in the United States between 1946 and 1954 appeared in the September issue of RUBBER WORLD on pages 773 and 774.

No More Rubber Footwear Tariff Cuts; Some Others Planned

The State Department has quietly let out the word that it is through with cutting tariffs on rubber-soled footwear coming into this country—at least for the next three years. The item was left off a 77-page list of products that the Department announced last month it is prepared to grant tariff concessions on in forthcoming negotiations with 35 members of the General Agreement on Tariffs and Trade organization to be held in Geneva in January.

Under the Reciprocal Trade Agreements extension law passed this year, the President can reduce tariffs 5% a year in the next three years—a total of 15% for the three-year period. State Department negotiators are prepared to go to Geneva in January to offer the full 15% cut in exchange for concessions by other GATT nations on American goods sold abroad. While it will negotiate the full 15% slice next year, the reductions will be staggered so only a 5% cut will take effect in the first year, 10% in the second, and the full 15% in the third.

Industry Protested Earlier Cut

Rubber-soled footwear was omitted from the negotiable items list, an official explained, because of the "furore" that developed over a duty reduction negotiated by the State Department with Japan earlier this year on imports of that product. The Japanese trade agreement, which took effect last month, cut the tariff on imported rubber-soled footwear from 35 to 20% of the wholesale price at which the equivalent American produced product sells. The reduction is available under the "most favored nation" clause to each of the 35 GATT members who want to export rubber-soled footwear.

American manufacturers of rubber footwear, speaking through the rubber footwear division of The Rubber Manufacturers Association, Inc., greeted announcement of that reduction with a storm of criticism and some sharply worded protests to the State Department and to the White House. Their demand that the duty cut be withdrawn by President Eisenhower—leaving the tariff unchanged at 35%—went unheeded, however. It is more than likely that these firms, in time, will seek to have the concession withdrawn via the "escape clause" route of the Trade Agreements law. This will require statistics showing an increased volume of imports injuring or threatening to injure domestic producers. They'll have to live with the lower duty on Japanese rubber footwear first before any figures measuring its impact on the domestic industry will become available.

The RMA's protest was grounded on its contention that the State Department, in contravention of law, failed to serve notice last November that rubber-soled footwear was among the items on which it was prepared to offer a tariff cut to the Japanese (and, through them, to other GATT nations). Three times in the State Department's formal notice mention was made of the Department's intention of negotiating a reclassification that would place a rubber-soled shoe with a hidden leather sole insert into the category of rubber-soled footwear. Prior to Congressional intervention in July, 1954, this item was classified as leather-soled footwear, taking a 20% import duty. RMA had supported the bill reclassifying this item as rubber-soled footwear, subject to a 35% duty.

State Department Error Involved

This Congressional mandate was carried out in the Japanese negotiations. But, in what RMA called a "sleeper," the entire category of rubber-soled footwear duties also was chopped. RMA said there was no indication that rubber-soled footwear was on the negotiable list, aside from a brief mention qualified, so RMA thought, by a footnote citing the Congressional law on reclassifying the leather-insert shoe as a rubber-soled shoe from tariff purposes. Had there been a clear notice of intent to cut the duty on rubber-soled footwear, RMA said, it would have raised an immediate protest before the Tariff Commission and had the item struck from the negotiable list for the Japanese trade talks.

The State Department's view of this matter is that there was a misunderstanding on the part of the domestic rubber footwear firms that came to light too late to rectify. The Department insists it complied with the due notice requirements of the law and that the footwear firms mistakenly read into a footnote more than was intended. In any case, it wants no part of a protracted controversy. Rubber-soled footwear is now regarded in the Department as a "sensitive item"—so sensitive that the government will bypass it completely in future negotiations carried on under its new tariff-cutting authority.

Cuts on Other Items Planned

While rubber footwear is off the list for possible tariff concessions at the January Geneva conference, some other rubber items are not. Among those subject to reductions of up to 15% off their present rates are synthetic rubber and synthetic rubber articles; products laminated with a synthetic resin; certain rubber drug sundries and surgical items; rubber combs; tennis and golf balls; and cords and tassels of cotton and rubber.

The Tariff Commission will start public hearings October 31; they are open to any domestic company wishing to protest possible duty cuts on any of the above items.

National News

Wage Increase of 12¢ an Hour Granted Firestone, Goodrich, and Goodyear Employes

General wage increases of 12¢ an hour resulted from negotiations between the Firestone Tire & Rubber Co., The B. F. Goodrich Co., and the Goodyear Tire & Rubber Co., in separate bargaining sessions between these companies and the United Rubber Workers of America, CIO, in August and September.

The Firestone settlement, effective August 29, included an additional 8¢-an-hour inequity increase for employes in the skilled trades and related classifications and inequity adjustments (amount not stated) for other non-incentive workers not included in the skilled trades.

The Firestone agreement also included increased vacation allowances and a seventh paid holiday to be selected by agreement at the local plant level. Make-up pay for jury duty and company-paid hospital and surgery insurance for retired workers and their families were a part of this agreement.

The new wage agreement between Goodrich and URWA also contained the 8¢-an-hour additional increase for certain skilled and maintenance classification workers and additional adjustments in rates for certain classifications other than skilled and maintenance employes. The seventh

paid holiday, liberalized vacation allowances for employes having 11 through 14 years' service, and make-up pay for jury duty were also a part of the Goodrich contract.

The Goodyear settlement was along similar lines as the Firestone and Goodrich company contracts with the 8¢-an-hour additional increase for skilled craftsmen, seventh paid holiday, and a 2½-week vacation annually for production workers with 11 to 15 years' service

In the case of the Firestone and Goodrich company negotiations, strike votes were taken by the union prior to the settlement, but this action was not a part of the Goodyear negotiations.

United States Rubber Co. began negotiations on wages with the URWA in Cincinnati, O., September 20; The General Tire & Rubber Co. began negotiations on wages with the URWA in Akron on September 19; and Goodyear Aircraft Corp. began talks with the union in Akron on the same day.

Previously, Quaker Pioneer Rubber Mills, Pittsburg, Calif., granted the URWA workers in its plant a 10¢-an-hour wage increase, effective July 1, 1955; a 6¢-an-hour increase, effective July 1, 1956; and a 5¢-an-hour increase, effective July 1, 1957, in a three-year contract, which also includes an additional paid holiday.

Electric Hose & Rubber Co., Wilmington, Del., granted its URWA workers a 11½¢-an-hour increase, effective August 20, 1955.

Columbia-Southern Chemical Corp., supplier to the rubber industry, announced on September 12 that it had signed a five-year contract with the Allied Chemical Workers union at its Barberton, O., plant, which included a 6% basic wage increase for the first year and 3% for each of the following four years. In addition, this contract calls for wage adjustments for skilled and semi-skilled employes, an improved pension plan, improved health and accident insurance, hospitalization benefits, a seventh paid holiday, an improved vacation plan, and increased life insurance.

Prices on Plane Tires, Mechanical Goods Raised

Prices for airplane tires and tubes were increased from 5% to 7½% by Goodyear on September 1, and all types of retreading of these tires were also increased 7½%, because of the substantial rise in the price of natural rubber.

The B. F. Goodrich Co. Industrial Products Division increased prices from 6% to 10% on various types of belting, 5.5% to 10% on industrial rubber hose, 8% on shoe products, 5% to 10% on molded industrial rubber items, 11% on rubber bands, and as much as 25% on certain miscellaneous rubber items which are made entirely of natural rubber, according to an announcement that was dated August 28.

The Goodrich increases were needed to recover the added costs of natural rubber, higher prices for steel resulting from the recent settlement in that industry, and other increased costs in the rubber industry, it was said.

O'Sullivan Rubber Corp. announced price increases ranging up to 12% for its heels, soles, and soling materials, on September 1, due to higher manufacturing costs.

These price increase announcements are cited as indicative of a trend which is characteristic of the rubber products industry at the present time and may be expected to continue as long as the various items which are a part of manufacturing costs, such as materials and labor, continue to increase in cost while productivity of men and machines increases at a much slower rate.

Other Industry News

Carbon Black Fillers Used in Linde Silicone Gum Stock

What is said to be the first successful use of carbon black fillers for silicone rubber has been achieved by Linde Air Products Co., division of Union Carbide & Carbon Corp., New York, N. Y. Heretofore, satisfactory reinforcement of silicone rubber has been possible only with silica-type fillers, at least under production conditions, the company declares.

Without revealing the types of carbon blacks used or the special compounding techniques, if any, employed, Linde says that many of the blacks it tested gave reinforcement equal to that obtained with silica fillers. Throughout these tests Linde's W-96 Silicone, a gum stock which features "controlled reactivity," according to the company, was used.

A reported comparison of typical post-cured properties of the two differently reinforced silicone rubber shows no appreciable variance in such properties as hardness, tensile strength, elongation, or brittle point. The carbon black silicone, however, had a noticeably greater compression set.

Linde neverless cautions that carbon black-filled silicone rubber is essentially an altogether new product and should perhaps be judged by standards different from conventional silicone rubbers.

The company is optimistic about the potential applications for carbon black-filled silicone rubber. One such application is as a conductive rubber with a greater operable temperature range than organic rubbers, such as required for airplane de-icers.

Coating Rayon with Resin

A process for increasing the wearing qualities of rayon cloth by applying a thin coating of a synthetic resin latex to the reverse side of the material has been developed jointly by Poughkeepsie Finishing Corp., Paterson, N. J., and Midland Textiles, Inc., New York, N. Y., it has been revealed by Naugatuck Chemical Division, United States Rubber Co., New York, N. Y., whose resin latex is being used.

The coating is permanent and remains unaffected by chemicals in the finishing operation or by cleaning fluids, it is claimed. In addition to improving the abrasion resistance of the rayon cloth by as much as five times, the process also increases seam strength, prevents raveling and fabric slippage at the cloth edges, and makes the cloth stiffer for more demanding applications, U. S. Rubber further reports.

Use of the treated material upholstery, especially as automobile seat covers, has been found practical because the applied coating does not diminish the porosity of the cloth. The resin is odorless and does not affect the luster of the rayon. The composition of the synthetic resin latex has not been revealed by U. S. Rubber.

L. A. Biggest Latex Port

Los Angeles Harbor is now the nation's largest receiving port for latex, the city's Harbor Department declared in early September at the dedication of the $100,000 Firestone Marine Latex Terminal built by the Department and leased to the American President Lines.

Capacity of the underground reception tanks composing the new installation is said to be 300,000 gallons, bringing the municipal port's total latex storage capacity to 455,400 gallons. Heretofore latex storage facilities at the port, leased to The Goodyear Tire & Rubber Co., were limited to a 155,500-gallon capacity.

Leonard K. Firestone, president, The Firestone Tire & Rubber Co. of California, who was among those present at the dedicatory ceremonies, declared that the increased demand for liquid latex from West Coast rubber manufacturers made necessary direct shipment of the material from the Far East, saving the cost of rail shipment from East Coast ports.

Research Reactor Owned, Operated by Industry

United States Rubber Co., New York, N. Y., will be one of a group of eight industrial companies planning to build and operate the first nuclear reactor to be owned and operated by private industry for research in industrial and humanitarian fields.

The facility will be known as the Industrial Reactor Laboratories and will be located on a 250-acre tract within commuting distance of New York. Options have already been taken on two sites in New Jersey and New York, but the final choice will be made by the Atomic Energy Commission, which will supply the fissionable fuel on a lease basis.

The plan for the reactor was first announced August 3 by General Walter Bedell Smith, chairman of the board and president of AMF Atomics, Inc., a subsidiary of American Machine & Foundry Co., and one of the participating companies. The other participants are Socony Mobil Oil Co., Inc., Corning Glass Works, International Nickel Co., Chas. Pfizer & Co., Continental Can Co., and American Tobacco Co., with other firms still expected to join the proposed venture, providing a true cross-section of American industry.

Actual construction of the reactor will be done by AMF Atomics at a cost estimated between $1,500,000 and $2,000,000. Work will begin in the fall, and completion of the project is expected in about a year. Operation of the Laboratories will be directed by a leading university, as yet unnamed, in accordance with a policy to be set down by a board of directors composed of representatives of the participating companies. Each company will have equal stock in the venture.

The reactor will be of the AMF so-called unitized design which is said to permit standardization of certain components resulting in ease of modification while preventing early obsolescence. It will be of the "swimming pool" type, using uranium fuel surrounded by water serving as a moderator, cooler, and shield. AMF is currently building a reactor of similar design for Battelle Memorial Institute, Columbus, O.

Each participating company in the enterprise will be free to perform its own industrial research under conditions that will protect its own discoveries. New products and new methods of manufacture are the essential aims of the project. In addition, part of the operating time of the reactor will be offered for medical research. The reactor will provide large-scale amounts of neutrons and gamma rays, as well as radio-isotopes.

In summing up the purpose of the joint venture, General Smith said, "While nuclear research is going forward in government and institutional laboratories, it is being retarded by priority government work and heavy demand from many companies. With this new facility, inquiry into the effects of radiation upon basic materials handled by these major concerns will be speeded up and the resultant benefits to humanity realized much more swiftly."

Chemical Sales Clinic

"Effective Selling of Chemicals" will be the theme of the fifth annual sales clinic sponsored by the Salesmen's Association of the American Chemical Industry, Inc., to be held at the Roosevelt Hotel, New York, N. Y., October 24, in conjunction with the Salesmen's Association's annual dinner.

Four addresses will be given before the morning session of the conclave. The speakers and their subjects are: Jack Klein, president, Klein Institute for Aptitude Testing, Inc., "Were You Born to Be an Effective Chemical Salesman?"; Robert A. Gopel, manager of sales personnel development, Koppers Co., "How an Ordinary Fellow Becomes a Salesman"; W. Edward Keegan, sales manager, Shell Chemical Corp., "The District Office—How to Run It"; and J. Warren Kinsman, vice president, E. I. du Pont de Nemours & Co., Inc., "You, the Salesman, and Your Management."

The afternoon session will be devoted to four panel discussions, running concurrently. The topics include "The Individual Salesman," "Training for Chemical Salesmen," "Administration of the District Office," and "Is Selling for Distributors Different?" A summary of the panel discussions will be given at a joint meeting afterward.

A cocktail hour and dinner will conclude the day's activities. Dinner speaker will be Henry B. Hass, president, Sugar Research Foundation, who will talk on the topic, "What Will You Be Selling Tomorrow?"

UCC to Erect Skyscraper

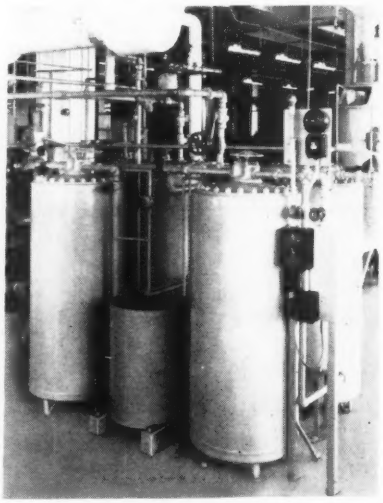
Union Carbide & Carbon Corp., New York, N. Y., will erect a 41-story building on the entire block between Park and Madison Aves., and 47th and 48th Sts., New York, N. Y., to house the home offices of itself and its divisions and subsidiaries. More than 3,000 of the firm's employes will be assigned to the new structure.

Cost of the proposed building is estimated at $40 million, and occupancy is scheduled for some time in 1958. The New York Central Railroad holds an option on the block-square midtown site, which Union Carbide will purchase. The building will be designed by Skidmore, Owings & Merrill.

Plant Maintenance Confab

The seventh annual Plant Maintenance & Engineering Show and Conference will be held in Convention Hall, Philadelphia, Pa., January 23-26, 1956. About 400 exhibitors and 2,500 engineers are expected to participate, according to Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y., show producer. The steady trend toward automation in American industry has increased the importance of the affair, Clapp & Poliak asserts, since the workman who formerly operated the machine now maintains it.

Permutit Demineralizers for Goodyear Airfoam Production



Double-unit demineralization plant at Goodyear's Los Angeles Airfoam producing facilities employing 28-inch-diameter Permutit ion exchangers to purify water

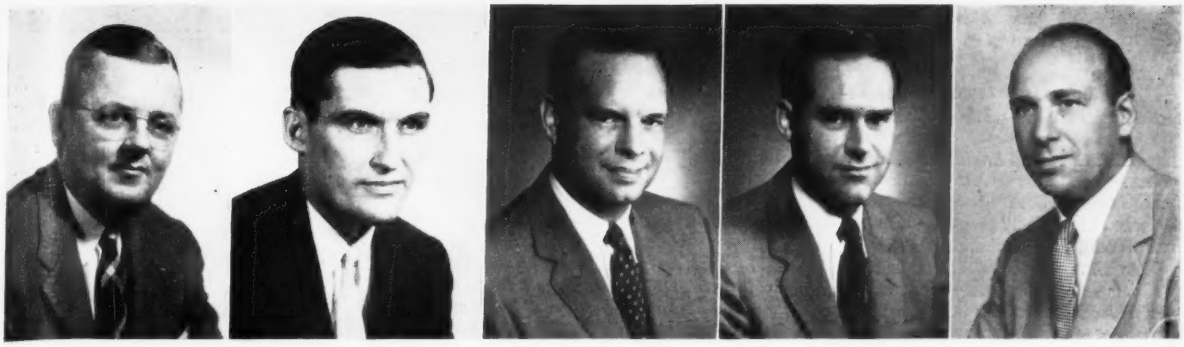
Demineralization of water by ion exchange has completely supplanted water distillation for the production of Airfoam at the Akron, O., and Los Angeles, Calif., plants of The Goodyear Tire & Rubber Co., according to J. E. Burwell, manager of compounding and service, Airfoam development department.

The distillation of water by steam condensation, used until 1950, was found to be uneconomical, as well as imposing undue hardship on available power-house facilities. To obtain the required purification of water, ion exchangers, employing cation and anion resins as the filtering media, were installed and have proved advantageous, Mr. Burwell said.

Made by Permutit Co., New York, N. Y., the ion exchangers are able to produce continuously demineralized water free of calcium, magnesium, and sodium salts, and with a purity of 3-5 parts per million total dissolved solids. Both the operation of the units and the performance of the routine control tests are relatively simple, Mr. Burwell stated, and a considerable saving in cost has resulted.

Reported water purification figures at Goodyear's Akron plant show the efficiency of the Permutit units, as given below:

	Before Demineralization	After Demineralization
Total hardness, ppm	150	0
Dissolved solids, ppm	165	3
Silica, ppm	4.6	0.1



S. W. McCune, III | E. Paul Hartsfield | Roger J. Barnhart | Harold E. Roth | R. A. Kurtz

Du Pont Elastomers Forms New Eastern Sales District

Formation of a new eastern sales district combining its former New York, Wilmington, and Atlanta districts into a single organization has been announced by E. I. du Pont de Nemours & Co., Inc., elastomers division, Wilmington, Del. The new unit will make its headquarters at 1750 N. Olden Ave., Trenton, N. J., and establish sub-offices in Charlotte, N. C., and Atlanta, Ga.

Samuel W. McCune, III, a 17-year veteran of the rubber and chemical industries, has been named manager of the new sales district, and E. Paul Hartsfield has been named assistant manager. Technical sales and development personnel reassigned there from the three old districts include A. H. Woodward, J. P. Fuller, R. H. Barton, M. A. Youker, R. S. Graff, R. N. Conklin, R. S. Griffin, and J. R. Galloway.

The company also reveals that the Chicago district has similarly been separated from the combined elastomers-dyes and chemicals management and set up as a separate unit of the elastomers division. Russell A. Kurtz, sales supervisor in Chicago, has been appointed manager of that district.

Named technical sales representative at the Charlotte, N. C., sub-office of the eastern district is Roger J. Barnhart. Appointed technical sales representative at the elastomer division's Akron sales district is Harold E. Roth.

Exide Battery Lease Plan

A plan to enable purchasers of electric fork and lift trucks to lease the required batteries and chargers for periods of up to five years with relatively low initial cash outlays has been announced by Roland Whitehurst, vice president and general manager, Exide Industrial Division, Electric Storage Battery Co., Philadelphia, Pa.

Exide is offering the choice of several leasing and purchase option agreements which would bring the average initial outlay for these trucks within range of the original cost of trucks powered by other means, according to Mr. Whitehurst. The battery and charger, worth approximately $2,800, the official says, would thereupon be leased to purchasers.

Borg-Warner Research Labs

Construction has begun on a multi-scientific Borg-Warner Research Center at Des Plaines, Ill., as part of an accelerated research and development program, according to Roy C. Ingersoll, president, Borg-Warner Corp., Chicago, Ill. The new facilities will contain equipment for metallurgical, electronic, electrical, chemical, acoustical, hydraulic, applied mechanical, physical, and nuclear research. Completion of the project is expected by next spring. This research center will replace the firm's smaller laboratory at Bellwood, Ill.

There will also be a complete machine and model shop, a modern computation center, and a technical reference library. About 100 scientists and engineers will be engaged at the start of the operation.

New Durez Plant Operating

Production of Durez[R] phenolic molding compounds has begun at the new $5,000,000 Kenton, O., plant of Durez plastics division, Hooker Electrochemical Co., Niagara Falls, N. Y., according to John F. Snyder, Sr., Hooker vice president.

The plant is completely modern and employs unique automation techniques, Mr. Snyder said. Phenol and formaldehyde, the raw materials of the phenolic molding compounds, are supplied by Hooker's North Tonawanda, N. Y., plant. The molding compounds are sold to custom molders and to manufacturers with their own plastics molding facilities.

Buys Plastic Hose Firm

American Hard Rubber Co., New York, N. Y., has purchased the assets of Industrial Synthetics Corp. and its subsidiary, Supplex Corp., both of Garwood, N. J., manufacturers of plastic lawn sprinklers and garden hose.

Albert A. Kaufman, president of Industrial Synthetics, will remain in an active executive capacity and will also join the management group of American Hard Rubber as a consultant to expedite development plans of the company, according to V. T. Norton, president of AHR.

Reclaim Industry Safety Up

Safety among workers in the rubber reclaim industry during 1954 showed some improvement over that of 1953, according to a survey conducted by the reclaim manufacturing committee of the National Safety Council's Rubber Section, Chicago, Ill.

The accident frequency rate dropped from 11.9 in 1953 to 8.62 for 1954, with a fall in the severity rate also noted, going from 1.38 in 1953 to 0.35 for 1954. The committee observed that a higher percentage of safety shoes and eye protection had been worn by employees during 1954, but the correlation did not hold for each of the 12 plants surveyed.

The statistics were based on 444,595 manhours worked during 1954, compared to 553,553 manhours worked in the preceding year. Each of the 12 plants surveyed had an average of 244 employes during 1954, a decrease from the average 269 employed in 1953.

Results of the inquiry were presented at the June meeting of the Rubber Section's executive committee in Grand Rapids, Mich. Chairman of the reclaim manufacturing committee is M. R. Batche, Xylos Rubber Co. The other committee members are R. M. Boyles, Midwest Rubber Reclaiming Co.; and R. J. Love, Pequanoc Rubber Co.

New Naugatuck Latex Plant

Naugatuck Chemical Division, United States Rubber Co., has put into operation its new latex compounding plant at Gastonia, N. C., intended to service regional textile, carpet, and paper plants with tailor-made natural and synthetic rubber latex formulations.

Built on an eight-acre tract of land, the plant has 30,000 square feet of manufacturing and storage space. This new plant employs high-speed mixing equipment, the company says: the latex flows through pipe lines from storage tanks to the compounding equipment, then into railroad tank cars or tank trucks, or is piped into drums subsequently shipped by trailer truck.

Named plant manager and sales manager to the Gastonia district is Claude H. Allard, a Naugatuck technical representative who covered the South for the past five years.

Award to Dow Corning for New Silicone Products

Dow Corning Corp., Midland, Mich., has been named the 1955 winner of the biennial Award for Chemical Engineering Achievement, sponsored by the technical magazine, *Chemical Engineering*, for Dow's pioneer work in the development of silicone resins, oils, and rubbers. The company was cited also for its process improvements in the field of silicones.

According to Dow Corning, the improvements include the following: a safe commercial process for using the hazardous Grignard reaction to convert silicon-tetrachloride to organo-silicon products; improvements in the direct metallic silicon conversion process that increased production 50%; more efficient polymer finishing processes that provide higher quality and richer yields; and new techniques in hydrolysis.

The company was selected to receive the award by an 84-member committee consisting of senior chemical engineering educators who head departments at colleges and universities accredited by the American Institute of Chemical Engineers and the Engineer's Council for Professional Development. The committee is headed by Walter G. Whitman, director of the chemical engineering department of the Massachusetts Institute of Technology.

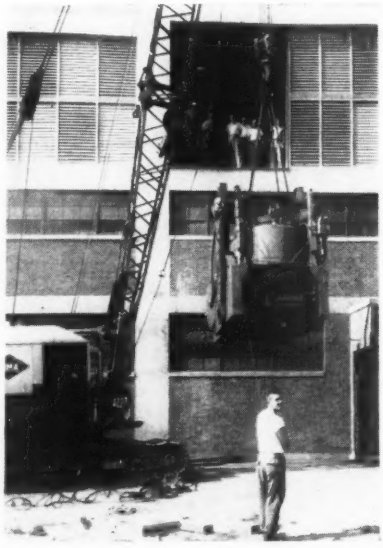
Twelve companies or industrial groups have previously received the award. Selection of Dow Corning marks the first time a company has been honored primarily for the successful participation of its chemical engineers in the commercial development of new products, markets, and sales, Dow Corning declares.

Formal presentation of the award will be made December 7 at a dinner in the Bellevue-Stratford Hotel, Philadelphia, Pa., in connection with the twenty-fifth biennial Exposition of the Chemical Industries. W. R. Collings, Dow Corning president, will accept the award.

Armstrong's Bag-O-Matics

Twelve 72,000-pound, 75-inch Bag-O-Matic presses for curing tires up to size 18.00/24 have been installed by Armstrong Rubber Co. for use in its West Haven, Conn., and Des Moines, Iowa, plants, it was revealed by Frederick Machlin, company president, who said they are the first of their kind to be installed in the rubber industry.

The 12 Bag-O-Matics, valued at $500,000, will be used to cure airplane tires, as well as large earthmover, tractor, and truck tires. The curing process in these presses is identical with that of the firm's recently installed 55-inch dual Bag-O-Matics; the length of cure varies with the type of tire, Mr. Machlin declared. All controls are automatic.



Crane lifting 75-inch Bag-O-Matic for installation in Armstrong Rubber Co.'s West Haven, Conn., plant

Firestone Safety Belt

Automobile safety belts made of two-inch-wide nylon webbing have been made available by The Firestone Tire & Rubber Co., Akron, O. These belts are designed to be anchored to the door and floor of the automobile and are said to be capable of withstanding forces up to 3,000 pounds.

Purpose of the design is to keep passengers from hurtling forward in case of accident or sudden stopping, Firestone explains, as well as to maintain closure of the door, which allows a vehicle to keep its maximum structural strength.

Highway officials are of the opinion that automobile safety belts can reduce the death toll from motor vehicle accidents by as much as 81%, Firestone reveals. The belts are expected to reduce injuries caused by sudden stops, accidents, and collisions and to reduce mental and physical fatigue.

Safety belts in the past have not found wide consumer acceptance, but observers believe that the rising highway death toll and increased public awareness of it may stimulate a trend to their use.

Shifts Plastics Equipment

Transfer of its plastics molding equipment from its discontinued Chicago Die Mold plant to its Fort Wayne, Ind., plant has been announced by United States Rubber Co., New York, N. Y. The company expects the Fort Wayne facilities to prove more adequate to accommodate its rapidly growing molded plastics business.

Larger molding presses will be added to the present equipment for molding products by the injection, compression, transfer, and plunger methods. Products to be manufactured include plastic pipe and fittings, electrical appliance parts, industrial parts, household devices, photographic equipment, packaging for food, pharmaceuticals, and cosmetics, and military parts.

Wire Cord Tire Revealed

Wire cord developed at the Newburgh Works of United States Steel Corp.'s American steel and wire division, Cleveland, O., has made a reality of the much-discussed tire that would outlast the life of an automotive vehicle, according to J. Carlisle MacDonald, U. S. Steel's assistant to the chairman.

The high carbon, brass-plated steel cord wire has a tensile strength of between 375,000 and 425,000 psi., far in excess of any available fabric cord. One of the nation's leading tire manufacturers has begun promotion of its 300,000-mile tire made with the U. S. Steel wire cord and is predicting a similarly constructed 500,000-mile tire within the next two years, Mr. MacDonald declared.

The cord wire is supplied in coils to the processing line as a hard drawn process wire 0.033-inch in diameter. The cord is built into the plies of the tire, two to four of which are formed in the carcass of the tire. Such construction makes possible a stronger tire with a thinner cross-section, providing greater resiliency, reducing heat accumulation, and eliminating casing stretch, the steel executive said.

Firestone Tire on Winner

The Super Sports 170, a sports-car tire developed by The Firestone Tire & Rubber Co., Akron, O., was used on the winning vehicle at the annual "Southern 500" Labor Day stock-car race at Darlington, S. C., which completed the 500-mile run at an average speed of 93 miles per hour without changing a tire.

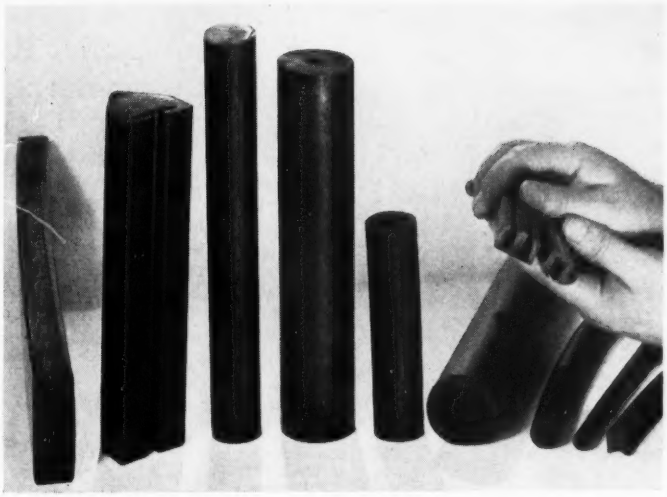
The Super Sports 170 is of nylon cord construction, with tread and sidewall of special compounds developed as a result of tests conducted on the Indianapolis Speedway and the Bonneville Salt Flats, as well as of tests in actual sports-car races, according to Firestone. The tire is said to combine maximum side and forward traction with high abrasion resistance.

Revealing that the tire will shortly be available commercially, Raymond C. Firestone, Firestone's executive vice president, declared: "The Super Sports 170 was designed and built to answer the demand for an American-built tire for sports-car owners. The fact that it has been successful in racing, especially on stock cars, is a tribute to our engineering staff."

Constructing Marlex Plant

Construction of a plant to manufacture Marlex polyethylene at a rate of 110 million pounds a year has begun, according to Phillips Chemical Co., subsidiary of Phillips Petroleum Co., Bartlesville, Okla. The plant is at the company's Adams Terminal chemical manufacturing site on the Houston Ship Channel.

A sales service laboratory will soon be built at Bartlesville to provide facilities for adapting plastics to customers needs, with initial emphasis on Marlex. Also being erected are new chemical research laboratories at the firm's research center, near Bartlesville.



Examples of rubber parts made by U. S. Rubber's new continuous molding process

Continuous Rubber Molding

A continuous molding process that can theoretically produce molded rubber parts of indefinite length has been announced by United States Rubber Co., New York, N. Y. The new technique, whose details have not been revealed, is said to be cheaper, faster, and as accurate as press or conventional molding and results in far closer dimensional tolerances than extruding, particularly in low durometer stocks.

The company is now producing through the new molding process seals for concrete pressure pipe, forms for concrete slabs, and engine mountings. Seals for double windows, sink spray hose, and windshield wiper tubing are being tested.

Customers can cut the exact length of goods needed, thus eliminating practically all scrap and reducing the cost of the spliced part, U. S. Rubber says. Concrete pipe manufacturers who have found extruded rubber gaskets too hard and not accurate enough are particularly singled out by the rubber company as beneficiaries of the new process.

Wing, Kellett Named

Loren E. Wing, resident manager of The Goodyear Tire & Rubber Co.'s field warehouse at Gadsden, Ala., has been named resident manager of the firm's new distribution center now under construction for use early in 1956 in Brook Park Village, near Cleveland, O., which will be the largest such installation in the rubber industry, according to the company. It will serve not only as a distributing point for tires, but for many other lines of industrial products and car and home supplies handled by Goodyear's large dealer organization.

Austin C. Kellett has succeeded Mr. Wing as manager of the Gadsden warehouse. He was formerly operating manager of the car and home division there. Mr. Wing has been associated with Goodyear for 31 years; Mr. Kellett for 26.

New ARco Subsidiary

Automotive Rubber Co., Inc., Detroit, Mich., has organized a new subsidiary, ARco Steel Fabricators, Inc., which will specialize in the design, construction, and installation of processing equipment for industry. Location of the new firm is in a recently built plant adjoining the parent company's general offices, laboratories, and lining plant at 12550 Beach Rd., Detroit.

The ARco subsidiary will complement the parent firm's rubber processing operations by furnishing it with tanks, vessels, pipe, fittings, and a variety of fabricated equipment for the application of corrosion-resistant rubber and plastic coatings and linings.

R. A. Jackson is general manager.

New Battelle Chem Building

A $1,400,000 chemistry building has been added to the facilities of Battelle Memorial Institute, Columbus, O. The four-story red brick structure now houses seven of the nine divisions of the department of chemistry, as well as one engineering division, and gives the Institute about 50% more laboratory space for chemical research.

In addition to laboratories for organic, inorganic, analytical, and physical chemical research, specialized facilities are provided for rubber, plastics, coatings, paper, leather, and lubricant technologies, the Institute says. Areas for plastics and rubber processing and for chemical engineering pilot-plant studies are also available.

The Institute has 240 chemists and their assistants in its employ.

Placco in Puerto Rico

A rubber goods manufacturing plant at Catano, San Juan, Puerto Rico, is now under construction by Placco Puerto Rico, which will make under license from Pioneer Latex & Chemical Co., Middlesex, N. J., a line of latex, rubber, and asphalt products, including asphalt roofing, waterproof and protective coatings, adhesives for the building, shoe, and paper bag trades, automobile undercoatings, and carpet backings. These facilities are expected to be in production by mid-January.

Placco will have available in bulk storage all of the required asphalt penetration grades to supply asphalt road surfacing formulations to any specification.

A Placco plant is now in operation at Cali, Colombia, with negotiations under way for the erection of others in Cuba, Mexico, and Venezuela.

A 660-ton Marion dragline, used by J. M. Huber Corp. to strip overburden at its Huber, Ga., clay mine, drops its nine-cubic-yard bucket for a capacity 15-ton bite of earth. The mammoth dragline, largest in the state of Georgia, has a 220-foot boom and is powered by a 1,000 hp. Cooper-Bessemer diesel engine

"Hypalon" Covered Belting Success in Hot Salt Handling

A hot-materials elevator belt covered with "Hypalon' chemical rubber has lasted six months during a field test at a large eastern chemical plant, more than double the life expectancy of belting heretofore available, according to E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., producer of "Hypalon."

Made by United States Rubber Co., New York, N. Y., the belt was 57 feet long and equipped with 56 Monel metal buckets which lifted hot salt from a direct-fired rotary drier to storage bins 27 feet above. The temperature of the salt averaged 300° F., du Pont says, with temperatures as high as 500° F. sometimes being recorded.

Belting for the handling of this salt formerly lasted no more than three months, breaking through embrittlement and cracking of the rubber and tying up the production unit. The "Hypalon" covered belt broke after six months, but failure resulted from embrittlement of the carcass itself, not the covering, du Pont declares.

The "Hypalon" covered hot-materials elevator belt has been introduced commercially as a result of the successful test.

Workman examining "Hypalon" covered elevator belt handling hot salt in an eastern chemical plant

New Name for Velsicol

Velsicol Corp., Chicago, Ill., chemical manufacturer, has changed its corporate name to Velsicol Chemical Corp. The firm, formerly a division of Arvey Corp., has its own corporate structure and believes the new title is more descriptive of its products and industry relations.

Announced simultaneously were title changes in the firm's executive personnel. J. Regenstein, Sr., has become chairman of the board and is succeeded as president by J. Regenstein, Jr., formerly vice president. E. T. Collinsworth, Jr., vice president and general manager, has been named executive vice president and general manager.

Velsicol produces insecticides, industrial resins, solvents, saturants, chlorine, caustic soda, and benzol. Its plants are located at Marshall, Ill., and Memphis, Tenn.

Kennett Fiber Receptacles

Kennett vulcanized fiber receptacles handling erosively coated soft rubber goods at Plasticoid Co., Inc., Elkton, Md., have remained undamaged after nine years of use, according to National Vulcanized Fibre Co., Wilmington, Del., manufacturer of the containers.

Corrugated shipping cartons and metal boxes were found to be impractical to hold the glycerin-and-alcohol-treated rubber goods for subsequent fabrication, since the first wore out quickly, and the second marked off. The Kennett receptacles are chemically resistant, tough, resilient, resist denting, and are rust- and corrosion-proof, the manufacturer says.

Timken Double "OO" Bearing

The only bearing plant in the world devoted exclusively to the production of tapered roller bearings in substantial quantities to predetermined tolerances of 75 millionths of an inch or better is the New Philadelphia, O., plant of The Timken Roller Bearing Co., Canton, O., the company declares.

These bearings, known as Timken Double "OO," must be accurate to better than 20 millionths of an inch, and the runout of a finished bearing is then accurate to 75 millionths of an inch or better, Timken says, believing that it is the only manufacturer capable of making these products in quantity to such predetermined accuracies.

The Double "OO" bearings are designed for the high precision requirements of the manufacture of such items as guided missiles, electronic computers, and machine tools.

The B. F. Goodrich Co., The Firestone Tire & Rubber Co., and **The Goodyear Tire & Rubber Co.,** Akron, O., and **Hood Rubber Co.,** Watertown, Mass., have been awarded the Certificate of Health Maintenance by the Occupational Health Institute for compliance with the standards of medical service in industry established by the Industrial Medical Association.

Pittsburgh Coke's New Phthalic Anhydride Unit

Pittsburgh Coke & Chemical Co., Pittsburgh, Pa., has started construction of a $3,000,000 phthalic anhydride plant on Neville Island in the Ohio River below Pittsburgh, it has been revealed by H. L. Hillman, president. The plant will be in production by the Fall of 1956 and will double the phthalic anhydride capacity of the company's coal chemicals division.

"Since 1948, when the company's existing phthalic anhydride plant began operating," Mr. Hillman said, "an extensive research program to improve the manufacturing process and product quality has led to technological advances permitting expansion of the capacity of the original plant and continuous improvement in product quality."

Stauffer Absorbing Firm

A plan to merge Consolidated Chemical Industries, Inc., San Francisco, Calif., into Stauffer Chemical Co., New York, N. Y., has been approved by the board of directors of both firms and will be submitted for approval to the stockholders of the two companies, with such approval expected before December 1. The merged companies will have total combined assets of $120,000,000.

The plan provides for an exchange of 3¼ shares of Stauffer common stock for each share of Consolidated Class A participating preference stock, excluding the shares of Consolidated owned by Stauffer. Stauffer holds all of the Class B voting stock of Consolidated.

If the merger is completed, 698,038 shares of Stauffer common stock will be issued in exchange for 214,781 shares of Consolidated Class A stock. Presently outstanding are 2,350,240 shares of Stauffer common stock.

The Consolidated Chemical Industries operations will be carried on under the name of Consolidated Chemical Industries Division of Stauffer Chemical Co. Stauffer's chairman of the board is Christian de Guigne. George L. Bond is president of Consolidated.

OBITUARY

William S. Kimley

William S. Kimley, retired analytical chemist for Spray-Dip Rubber Division, J. M. Cranz Co., Inc., Buffalo, N. Y., died September 8. He was 78.

Born in Waverly, N. Y., Mr. Kimley served on the faculty of Starkey Seminary and subsequently became associated with Hewitt-Gutta Percha Rubber Corp. as chief chemist. He joined Spray-Dip in 1935 and retired in 1952.

He held membership in the American Society of Chemical Engineers.

Funeral services were held in the Buffalo Crematory.

Surviving are his wife and three sons.

News about People

Fabian Bachrach

George J. Duffy

George J. Duffy has been advanced to general manager, minerals and chemicals division, Godfrey L. Cabot, Inc., Boston, Mass. He has been associated with the firm since 1940.

Ralph W. Updegraff and **Ross Russell** have been promoted to chief industrial engineer and divisional industrial engineer, steel and tube division, respectively, of The Timken Roller Bearing Co., Canton, O. Also advanced were **Charles L. Jolliff,** to general foreman of the Canton and Gambrinus bearing factory carpenters; **Don O. Gamble,** to general foreman of millwrights and painters in the Canton and Gambrinus factories; **Clyde L. Van Horn,** to chief cost accounting; and **Ward E. Pontius,** to auditor of the firm's Bucyrus plant.

Willard S. Gilbert has joined Naugatuck Chemical Division, United States Rubber Co., New York, N. Y., as sales representative in the latex and lotol department and has been assigned to the new Gastonia, N. C., plant for his headquarters.

Thomas S. Solomon, Heinz Uelzmann, and **Harvey Scott** have joined the staff of The B. F. Goodrich Co. Research Center, Brecksville, O., as research chemists. Also joining the Center's staff are **Paul J. George,** as senior technical man; **B. James Bailey**, as technical man in the physical research department; **Emin I. Arsan,** as technical man; and **Peter R. Fatianow** and **Carl A. Stearns,** as junior technical men.

Edward O. Hirschbeck and **Charles E. Wise, Jr.,** have been appointed plant operating engineers in the chemical engineering pilot plant of The Goodyear Tire & Rubber Co., Akron, O.

P. S. Brallier, director of market research and development for Stauffer Chemical Co., New York, N. Y., has been advanced to technical advisor to the president. Also promoted is **A. N. Wohlwend,** sales development manager, who now is director of market research and development.

John A. Price, John C. Mullarkey, and **Charles L. Balsingame** have been appointed technical service representatives by Oakite Products, Inc., New York, N. Y., to serve in the West Chicago, Phoenix, and Dayton areas, respectively.

Donald Parkinson, formerly manager of compounding research at Dunlop Rubber Co.'s research center, Birmingham, England, and associated with that company for 28 years, has joined United Carbon Co., Charleston, W. Va., and will initiate basic research for the firm in England in the uses of carbon black. He will also represent United Carbon in a technical capacity. A 1953 winner of the Colwyn Gold Medal of the Institution of the Rubber Industry, Dr. Parkinson is author of many papers on the reinforcing of rubber with carbon black and allied studies and is a widely known geologist, having once lectured in geology at Queen's University, Belfast, Northern Ireland.

Donald Parkinson

Rebman Photo Service

Jack J. Gruber

Rebman Photo Service

Joseph A. Hand

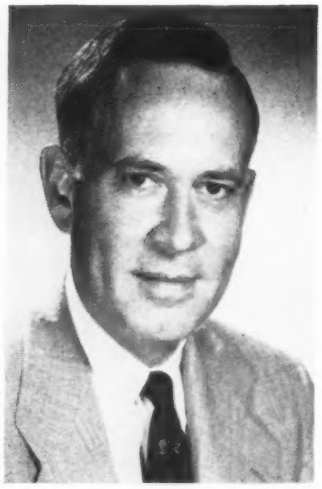
Joseph A. Hand has been reassigned as district representative for Michigan for National-Standard Co., Niles, Mich., and will be replaced as district representative for Ohio by **Jack J. Gruber.**

Howard Shannon, acting controller of American Hard Rubber Co., New York, N. Y., has been appointed vice president and general manager of Supplex Corp., Garwood, N. J., a subsidiary.

James E. Corbin and **Gordon W. Engdahl** have been advanced to technical directors, retail trade tape division and fibrous and industrial tape division, respectively, for Minnesota Mining & Mfg. Co., St. Paul, Minn.

Paul W. Bachman has been elected vice president and director of research and development for Koppers Co., Inc., Pittsburgh, Pa. Dr. Bachman has held high research posts with Commercial Solvents Corp. and Davison Chemical Co.

Thomas B. Nantz



Robert U. Haslanger

Robert U. Haslanger has been appointed director of industrial sales, Stauffer Chemical Co., New York, N. Y. He was formerly the firm's eastern sales manager.

George B. Baylis has been elected an assistant treasurer of Hercules Powder Co., Wilmington, Del., and **J. H. Tyler McConnell** has been elected secretary, succeeding Mr. Baylis, who had served in that position since 1948.

Bruce F. Smith, manager of technical service in the international department of Dow Corning Corp., Midland, Mich., has been appointed Montreal, P.Q., branch office manager of the company's Canadian affiliate, Dow Corning Silicones, Ltd., Toronto, Ont.

William E. Kelly has been appointed St. Louis district manager for the chemical division of The Goodyear Tire & Rubber Co., Akron, O., replacing **J. E. Warner,** recently named assistant manager in the division's coatings department.

Thomas B. Nantz has been appointed general manager of plants for The B. F. Goodrich Chemical Co., Cleveland, O., and will be succeeded as Calvert City, Ky., plant manager by **Walter E. Brodine,** formerly plant engineer there and project engineer at the firm's Louisville, Ky., facilities.

Frank J. Holmes has joined W. J. Voit Rubber Corp., Los Angeles, Calif., as factory manager of its sporting goods operation. He was formerly associated with The Goodyear Tire & Rubber Co. and Armstrong Tire & Rubber Co. and had participated in the Government's Synthetic Rubber Program during World War II.

Harold D. Cunningham has been advanced to general traffic manager for The Goodyear Tire & Rubber Co., Akron, O., and has been succeeded as division superintendent of warehousing and shipping by **Lewis C. Harless. Joseph W. Donnelly** has been promoted from department foreman to division foreman.

Charles E. Webb has been named manager of services at the Wyandotte, Mich., plant of Sharples Chemicals Division, Pennsylvania Salt Mfg. Co., Philadelphia, Pa. Replacing him as assistant to the general manager of the Division is **Albert Malmsten.**

Robert W. Adam has been promoted to manufacturing manager, Minnesota Mining & Mfg. Co., tape division, St. Paul, Minn.

John Rundt and **Alva Kopatz** have been appointed chief engineer and chief draftsman, respectively, of the division of research and development, The Timken Roller Bearing Co., Canton, O.

C. E. Campbell

C. E. Campbell has been named technical representative to the Washington, D. C., area for Velsicol Chemical Corp., Chicago, Ill.

Walter E. Brodine

Victor E. Buehrle, Jr.

Victor E. Buehrle, Jr., has been appointed technical sales representative for The General Tire & Rubber Co., Akron, O., for the firm's products to the rubber and reinforced plastics industries.

Robert D. White has been appointed New York, N. Y., branch manager of Hamilton Rubber Mfg. Corp., Trenton, N. J.

William M. Larson has been promoted to the rubber and plastics compounding section, research division, The Goodyear Tire & Rubber Co., Akron, O.

Arthur P. Kroeger and **Cyrus W. Merrell** have been advanced to associate director of marketing and assistant to the director of marketing, respectively, in the organic chemicals division, Monsanto Chemical Co., St. Louis, Mo. **William M. Russell** and **Tullius C. Tupper** have been transferred to director of sales—planning, and director of sales—operations, respectively, in the division, an exchange of functions.

J. M. Cole and **J. H. Mathewson** have been appointed production managers, and **George Trigaux** has been appointed assistant product manager in the fine chemicals division of Carbide & Carbon Chemicals Co., division of Union Carbide & Carbon Corp., New York, N. Y.

Thomas C. Watters, manager of the plant protection department at The Goodyear Tire & Rubber Co., Akron, O., has been named manager of the labor division of Goodyear Aircraft Corp., succeeding **E. R. Clarke,** who has resigned. **John F. Hogan**, superintendent of the plant protection department at Goodyear Atomic Corp., has replaced Mr. Watters.

Robert W. James has joined the sales staff of Vulcan Rubber Products, Inc., Brooklyn, N. Y.

L. B. Tewksbury has joined the diene synthetic rubbers section of The Goodyear Tire & Rubber Co., Akron, O. He was formerly with the University of Wichita Foundation for Industrial Research.

Richard G. Wells has been advanced to sales manager of Minnesota Rubber & Gasket Co., Minneapolis, Minn. He was formerly New York district manager for the firm.

Noel V. Wood, Jr., has been advanced to process engineering supervisor for Mobay Chemical Co., St. Louis, Mo.

J. D. Long and **A. F. Thomas** have been advanced to eastern and western division managers, respectively, for the films and flooring division of The Goodyear Tire & Rubber Co., Akron, O. Also named were **K. J. Whisler,** to Chicago district manager of the division; **C. E. Hixson,** to Dallas district manager; and **K. L. Weeden,** to Cleveland district manager.

H. F. Bulkley has been named director of public relations of the consolidated public relations department of Union Carbide & Carbon Corp., New York, N. Y., and **T. C. Fetherston** has been named assistant to the director; **George Sykes,** manager; and **W. P. Burglund,** assistant manager. Appointed heads of the advertising departments of the division companies are **R. W. Boggs,** Linde Air Products Co.; **G. B. Moynahan,** Carbide & Carbon Chemicals Co.; **L. F. Granger,** Electro Metallurgical Co.; and **J. P. Reap,** Haynes Stellite Co.

Henry B. Murphree has been advanced to assistant sales manager, U.S. tires division, United States Rubber Co., New York, N. Y.

George W. Blum has joined the chemical engineering staff of The Goodyear Tire & Rubber Co., Akron, O. He was formerly an associate professor of chemical engineering at Case Institute of Technology.

News Briefs

Dow Chemical Co., Midland, Mich., has reduced the price of its styrene N99 and styrene H99, polymer grades of monomer, to 20½¢ a pound, and styrene RG, the rubber grade of monomer, and vinyltoluene to 17¢ a pound. Sold previously on an f.o.b. basis, these monomers are now shipped freight allowed.

Pittsburgh Coke & Chemical Co., Pittsburgh, Pa., has formed a chemical procurement department to service the requirements of its chemical divisions, with J. W. McNeil named manager and H. A. Carpenter assistant manager.

Acme Backing Corp. has moved its general offices from Brooklyn, N. Y., to Canal and Ludlow Sts., Stamford, Conn.

Godfrey L. Cabot, Inc., white pigments division, Boston, Mass., has appointed Robert F. Sheahan Co., Memphis, Tenn., and Deeks & Co., Atlanta, Ga., sales agents in the middle-south and southeastern areas, respectively, for the distribution of Wollastonite, a calcium metasilicate extender pigment.

Minnesota Mining & Mfg. Co.'s Irvington Division, Irvington, N. J., has formed a new special products section for the development and sales of such non-electrical products as coated neoprene, silicones, oleoresinous materials, and vinyl. John W. Apgar has been named manager of the new section.

Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn., has introduced what is claimed to be an improved M-B-T-S powder, said to provide minimum dusting, excellent dispersion, and fine particle size. Bulletin No. 208, describing the material, is available.

The Dayton Rubber Co., Dayton, O., has introduced what are said to be the first tubeless tires designed specifically for trailer homes. A variety of sizes is available. The company will also supply tubeless tires as original equipment for trucks and commercial trailers.

Monsanto Chemical Co., St. Louis, Mo., is evaluating and developing formulations for vinyl foams under an experimental license obtained from Elastomer Chemical Corp. Monsanto's organic chemicals division, producer of plasticizers for polyvinyl plastisols, and its plastics division, supplier of vinyl dispersion resins, are working jointly on the program.

Rubber Corp. of America, Hicksville, N. Y., has acquired from Hecht, Levis & Kahn, Ltd., London, England, the entire share capital of its American subsidiary Hecht, Levis & Kahn, Inc., New York, N. Y. The purchase was made against the stock of the Hicksville company.

Roger Williams Technical & Economic Services, Inc., New York, N. Y., industrial market research consultant for the chemical industry, will construct additional executive offices in West Windsor Township, near Princeton, N. J.

Hercules Powder Co., Wilmington, Del., has added new facilities to its Gibbstown, N. J., oxychemical plant for the annual production of about 3,000,000 pounds of para-cresol. About 1,000,000 pounds of the material are being produced yearly at the firm's Hattiesburg, Miss., plant.

G & A Laboratories, Inc., Savannah, Ga., has contracted Battelle Memorial Institute, Columbus, O., to design, construct, and begin production of pelletized stabilized Galex rosin at Savannah, through a process Battelle developed for the firm.

Baldwin - Lima - Hamilton Corp. has opened a district sales office for hydraulic presses and testing equipment at 60 E. 42nd St., New York 17, N. Y.

Hewitt-Robins, Inc., Stamford, Conn., has been contracted to install a series of conveyors and allied equipment in the uranium processing plant of Rare Metals Corp. of America, Tuba City, Ariz., where U-308 is extracted from uranium ore.

The Firestone Tire & Rubber Co.'s New Bedford defense products plant has reached the 500,000th mark in its production of the 155-mm. shell for U. S. Army Ordnance. Manufacture of the artillery shell at the plant started in January, 1953.

The Goodyear Tire & Rubber Co., Akron, O., is producing a line of huge tubeless earth-mover tires, size 37.5-33, known as Wide Base Earth Movers, said to be the first tubeless and largest earth-mover tires ever made.

Parker Appliance Co., Cleveland, O., has named Globe Machinery & Supply Co. Iowa distributor for its Hoze-lok hydraulic hose fittings and synthetic rubber O-ring seals.

Financial

Aetna-Standard Engineering Co., Akron, O. Year ended June 30, 1955: net earnings, $1,037,790, equal to $2.58 a common share, compared with $1,229,852, or $3.05 a share, in the preceding fiscal year; sales, $20,467,453, against $26,576,394.

American Zinc, Lead & Smelting Co., Columbus, O. June half, 1955: net profit, $1,077,285, equal to $1.35 a common share, compared with $826,193, or 98¢ a share, in the corresponding months of 1954.

Anaconda Wire & Cable Co., New York, N. Y. First six months, 1955: net income, $3,083,612, equal to $3.65 a share, against $2,454,596, or $2.91 a share, a year earlier.

Baldwin Rubber Co., Pontiac, Mich., and subsidiaries. Year ended June 30, 1955: net earnings, $734,790, equal to $1.70 each on 433,028 capital shares, compared with $1,101,442, or $2.54 a share, in the preceding fiscal year.

Belden Mfg. Co., Chicago, Ill. Six months ended June 30, 1955: net income, $652,820, equal to $1.68 a common share, against $501,860, or $1.31 a share, in the 1954 half; sales, $12,821,758, against $10,-801,462.

Sidney Blumenthal & Co., Inc., New York, N. Y. Six months ended June 30, 1955: net loss, $564,746, against $526,471 loss in the 1954 half.

Borg-Warner Corp., Chicago, Ill., and subsidiaries. First six months, 1955: net profit, $17,877,436, equal to $2.39 a common share, contrasted with $9,990,738, or $1.35 a share, in the same months last year; net sales, $267,653,614, against $194,729,331.

Brown Rubber Co., Lafayette, Ind. January 1-July 2, 1955: net earnings, $426,-891, equal to $1.13 a common share, against $408,006, or $1.08 a share, a year earlier.

Brunswick-Balke-Collender Co., Chicago, Ill. Six months ended June 30, 1955: net loss, $288,869, against net loss of $345,869 in last year's half; sales, $13,-427,811, against $12,060,607.

Canada Wire & Cable Co., Leaside, Ont. Six months to June 30, 1955: net income, $931,000, against $759,000 in the 1954 half.

Philip Carey Mfg. Co., Cincinnati, O. June half, 1955: net earnings, $1,128,792, equal to $1.28 a share, against $1,009,016, or $1.21 a share, in the corresponding months of 1954.

Circle Wire & Cable Corp., Maspeth, L. I., N. Y. First half, 1955: net income, $856,998, equal to $1.14 each on 750,000 capital shares, against $751,116, or $1.00 a share, a year earlier; sales, $11,416,447, against $9,742,824.

Columbian Carbon Co., New York, N. Y., and subsidiaries. June half, 1955: net earnings, $3,147,619, equal to $1.95 each on 1,612,218 capital shares, compared with $2,486,348, or $1.54 a share, in the 1954 half; sales, $30,624,512, against $27,-155,806.

Cooper Tire & Rubber Co., Findlay, O. Six months to June 30, 1955: net income, $180,628, equal to $1.15 a share, against $124,613, or 79¢ a share, in last year's period.

Crown Cork International Corp., Baltimore, Md. Six months to June 30, 1955: net income, $513,564, equal to $1.32 a share, against $420,952, or $1.09 a share, in the 1954 period.

Dayton Rubber Co., Dayton, O. Nine months ended July 31, 1955: consolidated net earnings, $1,475,566, equal to $2.38 each on 590,552 common shares, contrasted with $568,891, or 85¢ each on 587,652 shares, in the 1954 period; net sales, $48,023,231, against $39,668,366.

Dow Chemical Co., Midland, Mich., and subsidiaries. Year ended May 31, 1955: net income, $37,414,257, equal to $1.64 each on 22,683,015 common shares, compared with $33,425,004, or $1.42 each on 22,651,010 shares, in the preceding fiscal year; net sales, $470,741,829, against $428,-255,219; income taxes, $35,900,000, against $24,400,000.

E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. Half ended June 30, 1955: consolidated net income, $186,392,-722, or $3.98 a common share, compared with $152,150,633, or $3.22 a share, in the like period last year: net sales $958,-145,656, against $833,186,414.

Garlock Packing Co., Palmyra, N. Y. June half, 1955: net profit, $676,804, equal to $1.61 a share, compared with $383,187, or 91¢ a share, in the '54 half.

Firestone Tire & Rubber Co., Akron, O., and subsidiaries. Nine months ended July 31, 1955: net earnings, $37,584,918, equal to $4.62 each on 8,074,836 common shares, compared with $28,314,009, or $3.51 each on 3,989,287 shares, in the like period last year; net sales, $804,542,-173, against $688,033,661.

Flintkote Co., New York, N. Y., and subsidiaries. Twenty-eight weeks ended July 16, 1955: net earnings, $2,390,778, equal to $1.71 each on 1,300,500 common shares, against $2,176,361, or $1.58 each on 1,265,835 shares, in the like period last year; net sales, $52,932,217, against $48,217,751.

General Cable Corp., New York. Six months to June 30, 1955: net income, $2,-950,114, equal to $1.27 each on 2,110,-332 shares, against $2,434,657, or $1.09 each on 1,934,597 shares, in the like period last year.

Glidden Co., Baltimore, Md., and subsidiaries. Nine months to July 31, 1955: net profit, $5,585,488, equal to $2.43 each on 2,295,340 capital shares, compared with $4,256,484, or $1.86 each on 2,291,-054 shares, a year earlier; net sales, $161,-330,745, against $153,057,671.

The B. F. Goodrich Co., Akron, O., and subsidiaries. Six months ended June 30, 1955: net profit, $22,291,357, equal to $2.52 a common share, compared with $18,232,853, or $2.16 a share, in the corresponding months of 1954; net sales, $372,355,401, against $304,935,288.

Goodyear Tire & Rubber Co., Akron, O., and domestic and foreign subsidiaries. June half, 1955: net earnings, $27,268,497, equal to $2.98 a common share, compared with $24,622,670, or $2.54 a share, a year earlier; net sales, $679,672,925, against $551,346,412.

Hewitt-Robins, Inc., Stamford, Conn. Initial half, 1955: net income, $485,271, equal to $1.57 each on 289,051 common shares, against $398,912, or $1.33 each on 287,051 shares, in the same months of 1954; net sales, $21,479,077, against $18,090,237.

Johnson & Johnson, New Brunswick, N. J., and domestic subsidiaries. Half ended June 30, 1955: net earnings, $5,888,000, equal to $2.79 each on 2,103,318 common shares, against $5,083,000, or $2.40 each on 2,097,617 shares, in the '54 half; sales, $111,419,000, against $101,845,000.

Lea Fabrics, Inc., Newark, N. J. Year ended May 31, 1955: net loss $321,662, contrasted with net profit of $502,388 in the preceding 12 months.

U. S. Rubber Reclaiming Co., Inc., Buffalo, N. Y. First half, 1955: net profit, $152,848, contrasted with net loss of $88,-490 in the first half of 1954.

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News from Abroad

Great Britain

One-Day Rubber Conference in London

A successful one-day conference on Recent Developments in Processing Rubbers, organized by the London Section of the Institution of the Rubber Industry, was held May 11, when some 300 members attended. The papers which were presented included:

"Superior Processing Rubber," by H. C. Baker.

At the Experimental Station of the Rubber Research Institute of Malaya, Superior Processing (S.P.) rubber is prepared by coagulating a mixture of fresh and vulcanized latex. Compared with standard rubber, S.P. rubber is said to have greater dimensional stability; masticating properties are similar, but smoother extrusions and calenderings with less shrinkage are obtainable; there is also less sensitiveness to over-mastication. Vulcanized S.P. resembles normal rubbers and also possesses satisfactory physical and aging properties.

"Easy Processing Special-Purpose Synthetic Rubbers." S. Mottram.

Methods to obtain easier processing acrylonitrile rubbers, without sacrificing important properties, include the use of chain terminators, to limit the production of high molecular weight fractions during hot emulsion polymerization; "cold" polymerization to limit branching in the polymer; and modification of compounding formulae. The last method involves the use of special, low molecular weight nitrile polymer as a plasticizer in standard nitrile rubber. Similarly, nitrile rubbers in crumb form serve as a 25% replacement for normal polymer.

"Improvement of Mixing on Two-Roll Mills." I. L. Hepner and G. N. Welding.

Addition of colored substances to rubber on a two-roll mill facilitated visual study of the mechanism of mixing. Observations suggested that mechanical distribution of powders should provide lateral uniformity and directional alternation of the band of rubber entering the bank, so that fillers are added to the outer surface, and then to the "dead" layer in contact with the roll, which should make cross-cutting unnecessary. A special method of measuring rate of achievement of uniformity gave quantitative confirmation of the improvement of efficiency.

"Heat Sensitization of Latex Compounds." E. G. Cockbain.

Discussed chiefly was the heat sensitization of latex by organic nonionogenic polymers, particularly polyvinyl methyl ether (PVME) and the polyoxypropylene glycols (POPG). The properties of these two substances were compared, and the factors influencing heat sensitivity were described and illustrated in the case of dipping, for PVME, and dipping and casting, for POPG. Preparation of latex foam goods with POPG was compared with the sodium silicofluoride process, and also properties of the final products were compared.

"Development in the Design of Rubber Processing Machinery." E. Morris.

The improvements considered ranged from modern high-speed internal mixers with individually driven rotors, in mechanized layouts with strainer-extruders and pelletizers, to new-style calenders with preloaded bearings and redesigned cooling systems in the rolls which can be skewed and are driven individually. Heavy-duty presses with deeper heads for stiffness, to facilitate molding to close tolerances, and with drilled steel platens fitted with multiple steam inlets for better temperature uniformity, were described as well as the latest design of continuous vulcanizing equipment for sheeting, belting, etc. Developments in control instruments for vulcanizing plant were also briefly reviewed.

"Recent Developments in Ancillary Processes." M. M. Heywood.

Discussion centered on the production of pelleted stock and its direct use in molds; the cleaning of steel molds—for which the blow-lamp was recommended, followed by brushing or the application of a mild airblast carrying ground nut shells, and phenolic solutions for aluminum mold alloys (provided operators are protected); and the finishing of molded goods. For certain types of rubber, dry-ice rumbling of small moldings was said to be efficient; even the internal flash on molded rings could be removed without spoiling the accuracy of dimensions.

British Trade Notes

The Port of London now for the first time also has facilities for the discharge and storage of latex in bulk, thanks to arrangements made with the Port Authority by Wm. Symington & Sons, Ltd., which resulted in the erection of an installation equipped to deal with large quantities of bulk latex.

Butadiene for the manufacture of special-purpose synthetic rubber is to be produced under the new plans for expanding the output of petroleum chemicals, at the Grangemouth plant of British Petroleum Chemicals, at a cost of £8,000,000. The necessary butadiene separation plant will be built and engineered by the Kellogg International Corp. British Petroleum Chemicals is jointly owned by British Petroleum Co. and Distillers Co.

The Institution of the Rubber Industry on June 18 moved to new headquarters at 4 Kensington Place Gardens, London W.8, England.

Germany

Tubeless Tires on the German Market

Tubeless tires are now also appearing on the German market. Metzeler Gummiwerke A.G. first introduced its tire in December, 1954, and Continental Gummiwerke shortly afterward. In early January. The latter concern had been working on tubeless tires for several years and had even applied for a patent in 1943, which was refused on the grounds that it was improbable that the invention had practical utility.

Continental solves the problem of preventing air-escape by giving its tubeless tire an airtight rubber lining on the inside surface, providing a series of ribs at the base of the tire between tire and rim edge, to form a kind of labyrinth seal, and finally by sealing the valve opening on both sides of the rim by two rubber disks. The metal valve is passed through the valve opening and screwed tightly to the drop center rim.

Metzeler provides its tire with two elastic sealing rings which lie between tire bead and rim edge; air pressure forces the bead so tightly against the rings and hence to the felly that perfect sealing is assured even under conditions of severe strain.

Other German tire manufacturers, including Veith, Phoenix, and Dunlop, will shortly also be producing tubeless tires on a commercial scale.

Three of the companies, Continental, Veith, and Phoenix, are working together with American tire manufacturers. Continental's agreement with Goodyear Tire & Rubber Co., recently signed, provides for an exchange of information and also for Continental to produce tires for Goodyear. The German firm had for several years previously had an understanding with The General Tire & Rubber Co.; however, this connection was amicably severed November 30, 1954, by mutual agreement.

Veith Gummiwerke has an arrangement with The B. F. Goodrich Co. along lines similar to that of Continental and Goodyear. The Sandbach works are to be expanded and modernized, and Veith tires will be sold in future under the name, "Veith-B. F. Goodrich."

Phoenix is associated with Firestone Tire & Rubber Co. in the production of tires in Germany where the "Phoenix-Firestone" brand has been appearing since 1953.

Average hourly output using Silastic 401 Gum
Average hourly output using ordinary silicone gum
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NO SPRINGS - HONEST WEIGHT
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Malaya

"Third Great Slump Ahead"

At a recent meeting the chairmen of a Malayan rubber company presented a picture of what may be in store for the rubber plantation industry, which is less than reassuring.

J. K. Swaine, chairman of Bukit Sembawang Rubber Co., foresees "the third great slump" in the rubber industry. He blames the government replanting scheme for the shortage of rubber which is responsible for the present high prices. Acting on the advice of theorists, he says, the government by inducements and threats of penalties has exerted pressure on producers to replant at a rate far in excess of requirements so that mature areas have been cut out on a scale that would not have been considered prudent had there been no government interference. The mounting loss of crop that must follow in the next few years may well lead to even higher prices, forcing more and more manufacturers to use synthetic rubber. Then as the vast areas replanted with high-yielding stock under the government scheme come into bearing, prices will fall, until finally cutthroat competition with synthetic rubber will be the prelude to the unfortunate result predicted.

Scheme for Forward-Contract Duty Payment

A government scheme for registering forward contracts and fixing the duty payable in advance of actual shipment has been under discussion by the government and representatives of the various sections of the rubber industry here. Under the present system, export duty and the anti-inflationary cess levied when rubber is more than $1.00 (S.S.) a pound are paid on the price prevailing at the time of shipment. The new scale of duties introduced last June provides for considerably higher rates on rubber at prices above $1.00 a pound, but there is no special provision for forward sales. In the face of steadily mounting prices, many producers who would otherwise make forward contracts refuse to risk the chance of having to pay duty on a higher price for rubber than that at which they sold, so that forward selling has been much restricted, and the market is deprived of its stabilizing effect.

The need of suitable measures to correct this undesirable situation was brought to the attention of the government by the Rubber Producers' Council, when a plan was drawn up, apparently similar to one in operation in Ceylon for four years. Under the scheme in Malaya, it is proposed to set up a Central Registration Office in the Customs Department; those who choose to register contracts, must make application within seven days after the contract has been signed; contracts are to be filled within three to 12 months from the date of their signing. The rate of duty is to be fixed on the day of registration either on the selling price or on the price ruling at the time of registration, whichever is higher; applicants must provide a banker's bond or guarantee for the full amount of duty due on the amount of rubber covered by the contract. Once a contract is registered, duty is payable even if it is broken by one of the parties involved. There is to be a registration fee of $50 (S.S.) to cover cost of administering the plan.

Rubber producers and shippers are not completely satisfied with the scheme; they want the duty to be fixed on the actual selling price; as they point out, prices on forward contracts are usually lower than those for immediate shipment, and, furthermore, by reserving to itself the choice of the higher price on which to fix duty, the government would be seeking to get more than it is entitled to. The requirement of a banker's guarantee and the $50 registration fee are also objected to as likely to work hardship on the small man. The question of the manner of levying the inflationary cess on forward sales must also be clarified.

These are the main points put forward at talks between the representatives of the appropriate government departments, the Rubber Producers' Council, the Federation of Rubber Trade Associations, Chambers of Commerce, and bankers.

New Pay Raises for Labor

The boom in rubber prices has necessitated a revision of the wage scale for rubber workers, and rates have now been fixed, based on rubber prices as low as 40 cents a pound and up to $1.50 a pound (Straits currency). Workers are to benefit by the new agreement in two respects. First, they will be guaranteed a minimum wage even when the price of rubber drops to 40 cents, that minimum being the same rate as that prevailing when the price is between 50 and 60 cents a pound, that is, $2.55 daily for contract tappers, $2.30 for check-roll tappers, and $2.05 for field workers. Second, the rates of increase in daily pay following each rise of 10 cents in the average rubber price for a given quarter are to be five cents higher when the average price is more than $1.00 a pound, so that there will be 20, 15, and 10 cents more daily for the different categories of workers, instead of 15, 10, and 5 cents, respectively.

Since the average price for the third quarter of 1955 is expected to be between $1.30 and $1.40, against the average of 90 cents to $1.00 in the preceding quarter, rubber workers stand to get an increase in daily pay of 80, 60, and 40 cents, respectively, and the daily wage during the last three months of the current year will amount to $3.95, $3.30, and $2.60, for the three categories, respectively.

Evidently the advantage of an assured wage rate at low as well as at high price levels, plus the other benefits offered by estates which are members of the MPIEA, has sufficient appeal to keep most workers on these estates. The special bonuses that some estates are giving workers for good attendance must also help. A report by the Labor Department indicates that in July there was no marked movement from estates to smallholdings. To be sure, certain estates were experiencing a shortage of labor, but apparently these are concerns that have always had recruiting difficulties.

On the other hand, there is no doubt that unusual earnings are made by tappers working on a share basis on smallholdings in some parts of the Federation; in Pahang the average is reported to be about $200 a month, and in one section of Johore the daily earnings are said to run as high as $10 to $12.

Rubber Thefts

Stealing rubber from estates has for some time been rampant in certain parts of Malaya, and total thefts are said to run into several million pounds a year. With the present high prices this activity has become highly attractive and is on the increase; some estates are reportedly losing as much as one third of their crops in this way.

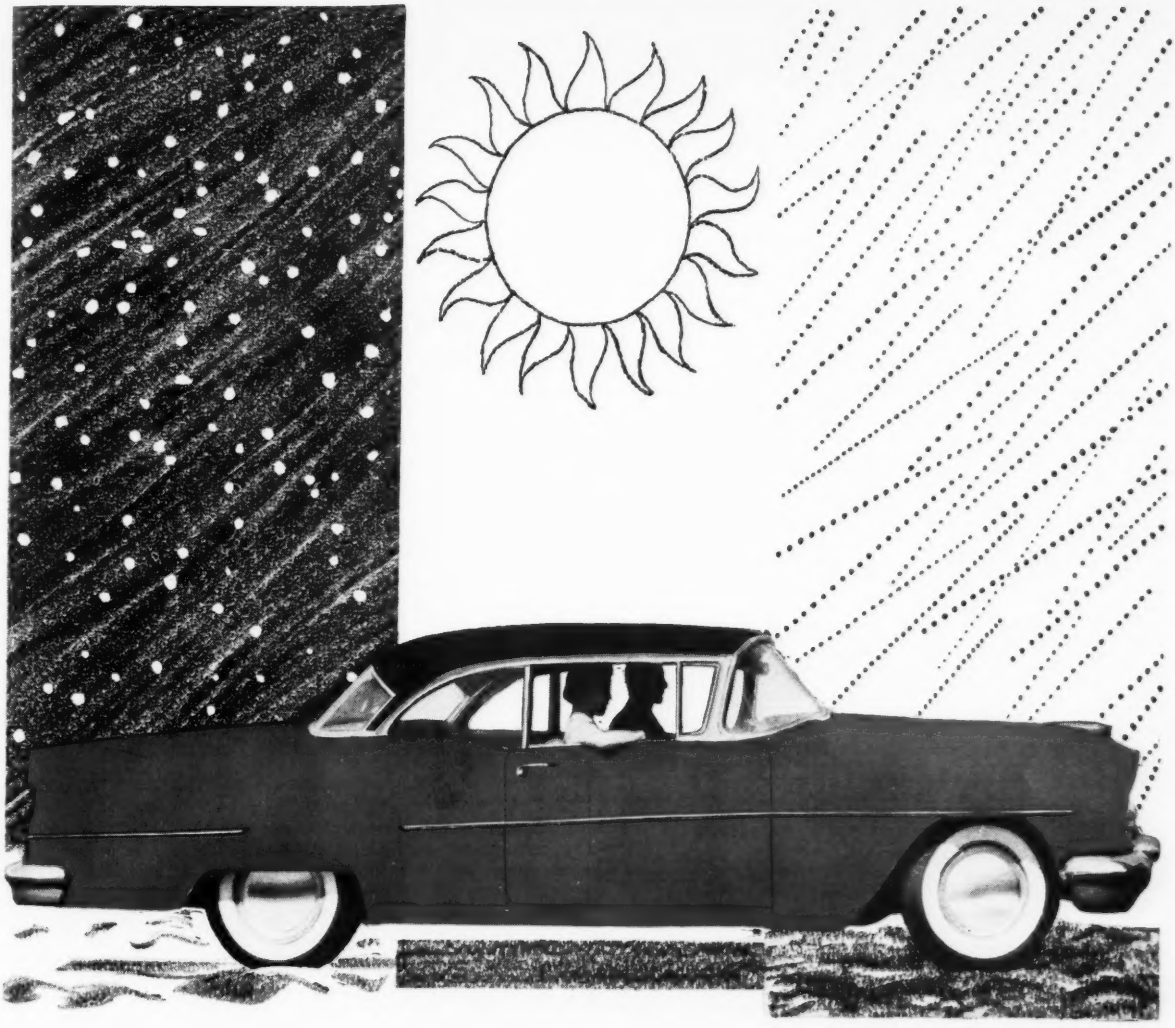
To beat the thieves, *The Planter* outlines a plan which requires the addition of a fluorescent substance to the latex at the factory, processing otherwise to proceed as usual. Then suspicious lots of rubber could be checked by fluoroscope. To help identify the source of the stolen rubber, different estates could use fluorescent material of different colors.

Netherlands

Rubber Stichting to Bogor

A communication from the Rubber Stichting, Delft, dated July 15, states the terms of the decree of the Government of Indonesia on the transfer of the Rubber Stichting to Indonesia. It declares that the Government of Indonesia fully realizes the significance and value of the Rubber Stichting, at Delft, for the promotion of the use of natural rubber in general. However, its headquarters are at too great a distance from Indonesia so that the Government of Indonesia cannot deal as directly as desirable with organizational and personnel matters or the activities of the Stichting. The Indonesian Government consequently feels that its management is not properly justifiable before Parliament or smallholders, the latter of whom, like the rubber estates, are directly concerned. Furthermore, since the activities of the Stichting are carried out in the Netherlands, its financing requires the provision by the Indonesian Government of considerable sums in foreign currency. For all these reasons, the Indonesian Government has decided on the transfer of the Stichting to Bogor.

The Stichting, established in 1935, is financed by the Government of Indonesia out of levies on the export of natural rubber. The entire personnel, including about 250 persons, is Dutch. The Director of the Stichting, R. Houwink, considers that it will not be possible to continue in Indonesia the work that has been carried out in Delft, without the same staff, and adds that it is hardly likely that Dutch personnel will apply for employment in Indonesia.



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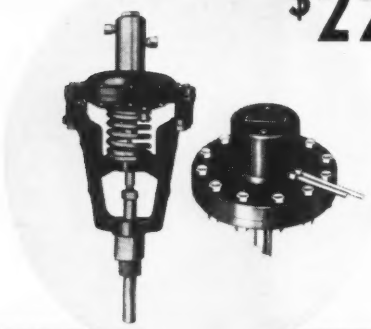

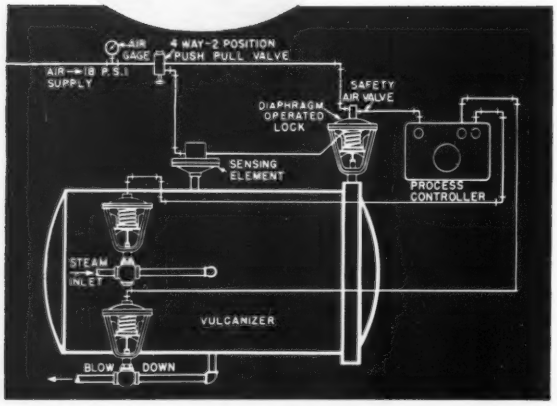

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WESTON *Instruments*

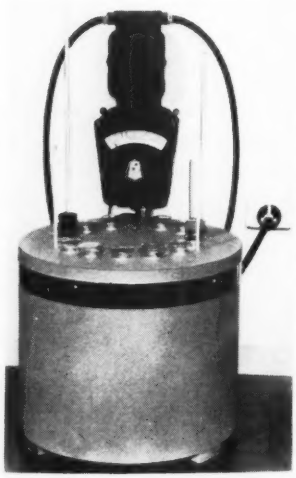
NEW EQUIPMENT

Sterlco Model 6031

Triple-Temperature Control Unit

A new triple-temperature control unit for temperatures up to 240° F., which is a self-contained device for heating or cooling water, particularly designed for use in the manufacture of plastic sheet, but said to show possibilities for application in the rubber industry, has been placed on the market by Sterling, Inc., Milwaukee, Wis. Called Model 6031, the unit can increase the speed and improve the quality of sheet manufacture by maintaining each calender roll at the proper temperature, the company says, and the device is also suited for injection molding and vacuum forming operations where three separate stabilized temperatures are required.

Fast heating, adjustable and automatic heating control, low water capacity, high water velocity, and modulating cooling control are reported to be some of the unit's features. It is compact and portable and operates in a temperature range of 60-240° F.



Comet Model 600

Laboratory Aging Block

An aging block for use in rubber and plastics laboratories that automatically controls precise temperatures from 100 to 600° F. has been introduced by Product Packaging Engineering, Culver City, Calif. Designated Comet Model 600, the 15- by 18-inch, 175-pound unit contains 13 test-tube compartments for test-tube aging, according to ASTM Method D865-52-T, and aging in fluids such as oils and fuels. The block is made of machined aluminum, with a removable bottom plate for maintenance, and has baked enamel and chrome plated external parts.

This device, furthermore, operates on a 220-volt, AC current.

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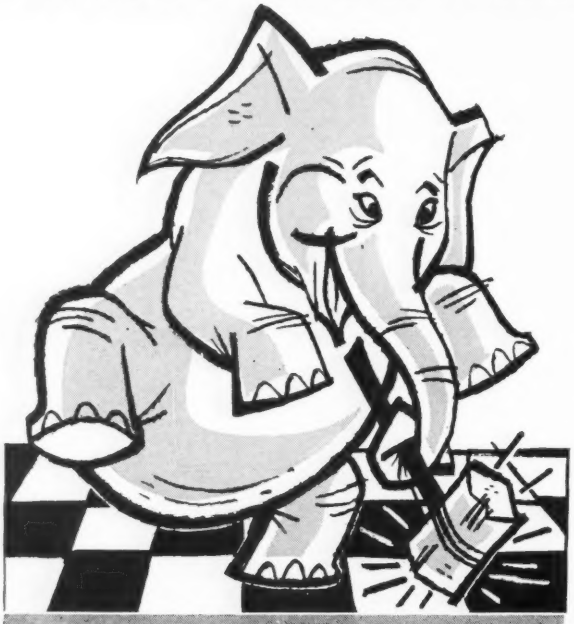

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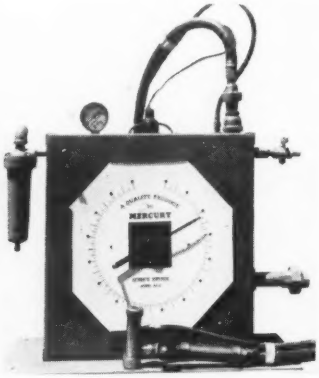
Scott L-8 Hot-Cold Tensile Tester

Tensile Tester for Elastomers

An instrument for determining modulus in tension, tensile strength, per cent elongation, and tear resistance of elastomeric materials at temperatures ranging from —70 to 550° F. has been placed on the market by Scott Testers, Inc., Providence, R. I. Called L-S Hot-Cold Tester, the device consists of a basic or test unit and a conditioning unit. The test chamber can be equipped with a simple pendulum-type weighing system or one which registers electronically. The unit can be supplied with one rate of pull, with a set number of specific rates of pull, or with completely variable rates over a wide range of speeds.

The conditioner is equipped with 6,000 watts of electrical heating capacity, and with cooling coils and dry-ice chamber. Operable manually or with automatic controls, the unit records temperature readings by means of a Brown recorder. The heaters require either a single- or three-phase, 220-volt circuit. The circulating fan, recorder, and automatic controls need a 110-volt, 60-cycle, single-phase circuit.

Vinyl Plastisol Dispensers



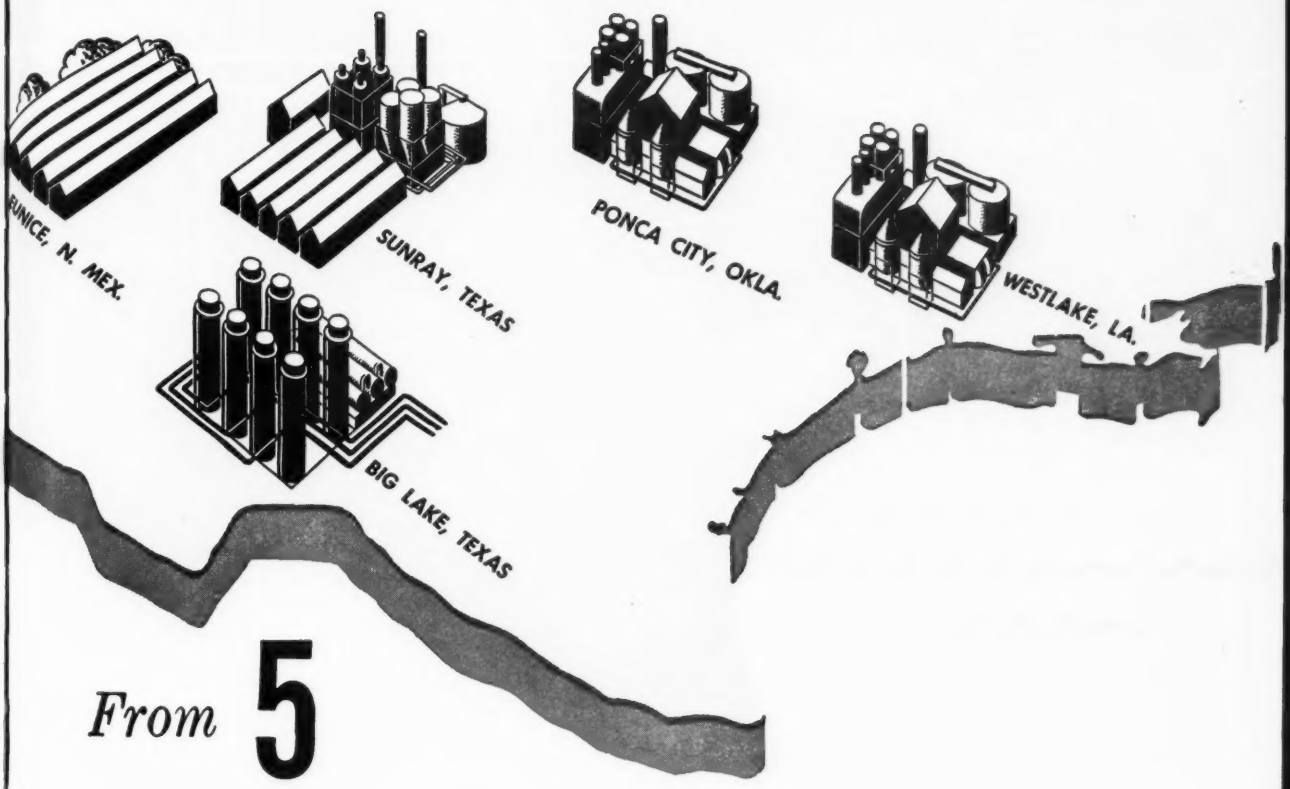
Model AD-E Meterite Automatic Dispenser

Three new models of vinyl plastisol dispensing units have been introduced by Mercury Industries, Inc., Hillsdale, N. J. Called Meterite Automatic Dispensers, they include Model AD, for highly accurate adjustment of quantities from 15 to 1,600 grams; Model AD-E, for quanties from 12 to 1,300 grams, specially designed for instantaneous adjustment from one measurement to another; and Model MD, a manual and non-measuring unit for bulk dispensing. All models have drip-proof nozzles.

Quick-Opening Exchanger Door

A self-seating, quick-opening door, particularly suited for use on heat exchangers that carry fouling liquid and require frequent

(*Continued on page 120*)



From **5**

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A COMPLETE LINE OF CARBON BLACKS

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CHANNEL BLACKS

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Witco No. 12
Continental A (MPC)
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MAGNESIA GUIDE

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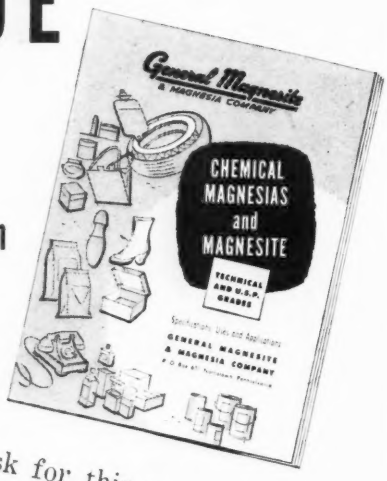

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Technical and U. S. P. grades; EXTRA LIGHT — the original neoprene type; also Light, Medium, and Heavy grades.

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NEW MATERIALS

Butadiene-Styrene Copolymer Latex—Vult-S 8-VX-5

A butadiene-styrene copolymer latex in 45/55 ratio has been made available by General Latex & Chemical Corp., Cambridge, Mass. Called Vult-S 8-VX-5, the material, first in a projected series, is supplied primarily without antioxidant and with a moderately high surface tension, but it also can be obtained with antioxidant and with low surface tension and high frictional stability. Suggested applications include its use in adhesives, coatings on non-metallic materials, saturants for paper and fabric products, and in electrical insulation.

Some typical physical data on Vult-S 8-VX-5 are reported as follows:

Weight/gal., lbs.	8.3
Total solids content, %	39
pH	11.0
Surface tension, dyne/cm.^{2}	55
Mooney (ML-4)	90
Free styrene, %	0.13
Viscosity (Brookfield) #1 spindle, 6 RPM.	20
60 RPM.	18

A technical bulletin on this material is available from the company.

High Modulus Polyethylene

A high modulus polyethylene said to offer higher heat tolerance, greater toughness, rigidity, and chemical resistance, and better appearance is being offered by H. Muehlstein & Co., Inc., New York, N. Y. Called Super Modulene, the plastic, made for Muehlstein by Koppers Co., is claimed to have extreme low-temperature toughness, about three times the burst strength of ordinary polyethylene, and shows only a 2-4% dimensional change and no loss of surface finish at 250° F. Liquid or vapor diffusion through the new plastic is about one-third that of ordinary polyethylene, the company declares.

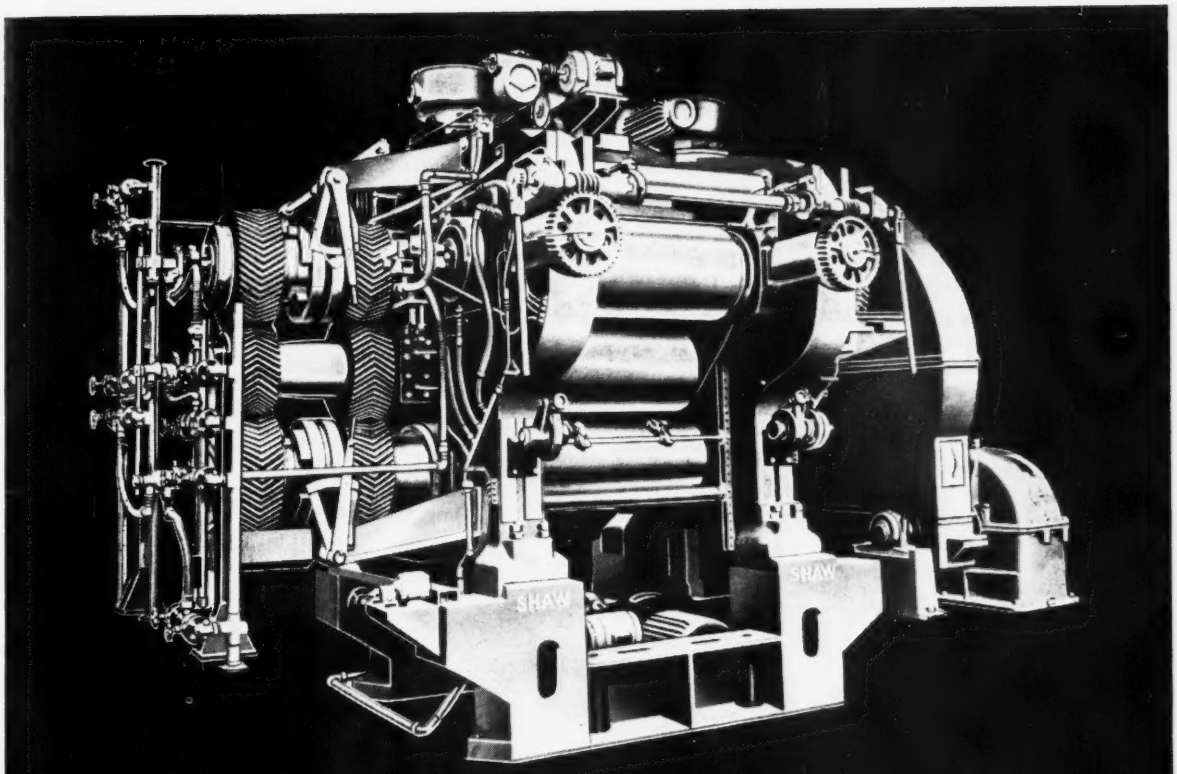
UCC's 1,5 Pentanediol

Another in its series of acrolein derivatives, 1,5 pentanediol, has been made available by Carbide & Carbon Chemicals Co., division of Union Carbide & Carbon Corp., New York, N. Y. According to the company, the diol undergoes reactions typical of glycols, forming esters and polyesters that are important intermediates in the manufacture of polyester resins, urethane foams and elastomers, fibrous glass-reinforcing resins, magnet and wire enamels, and other resinous materials.

Stable Surfactant Series—Kel-F Acids

A series of perhalogenated, monobasic carboxyl acid surfactants derived from chlorotrifluorethylene has been introduced by M. W. Kellogg Co., New York, N. Y. Called Kel-F Acids, they are said to be characterized by thermal stability in temperatures up to 450° F., resistance to strong acids and oxidants, selective reactivity of a carboxylic acid, and to have surface activity in highly acidic, basic, or oxidizing media, as well as low vapor pressure and high density.

(Continued on page 120)



SHAW

PRECISION CALENDERS

Well in front of contemporary designs of machinery for the Rubber Industry, SHAW Calenders are the latest word for flawless production, complete reliability, and very long life. They are supplied with 3 or 4 bowls for all types of Synthetic and Rubber materials. Among the many refinements included in the design of this outstanding machine are: bored and/or drilled rolls for heating and cooling, flood lubrication to the Roll Bearings, and hydraulically operated zero clearance.

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GREATER ECONOMY IN VINYL FILM LAMINATING INTEREST YOU?

ARCCO C 510 Heat Seal Solution Laminant offers these advantages over direct calendering:

Spreader knife application of base coat, any time prior to lamination, simplifying production schedules.

Lamination and embossing accomplished in one pass, an important processing economy.

Small orders easily processed without upsetting calender schedules.

Laminating with ARCCO C 510 eliminates necessity of making up small lots of coating compound.

Non-reclaimable scrap vinyl compound eliminated.

Greater versatility. Fabric base coated with ARCCO C 510 can be laminated to vinyl film ranging from .004" gauge to .020".

Other ARCCO Heat Seal Solutions and Emulsions provide excellent adhesion to cotton, wool, rayon and leather, and can be tailor-made to meet your individual requirements.

An ARCCO engineer will be glad to call and give you complete information about the characteristics and uses of ARCCO C 510 Heat Seal Solutions and Emulsions for vinyl films and as Heat Seal Coatings for fabrics.

ARCCO offers a complete compounding service for emulsions, solutions and hot melts, both standard and specialized formulae. Feel free to consult our ARCCO Technical Service about your specific requirements.

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IN CANADA: American Resinous Chemicals of Canada, Ltd., 20 Trent Ave., Toronto, Canada

NEW PRODUCTS

Insulair Vagabond Jacket

Vinyl Foam Lines Jacket, Vest

An outdoor-wear jacket and vest employing an inner liner of expanded vinyl foam that insulates against cold and wind and is buoyant enough to float the wearer have been placed on the market by United States Rubber Co., Rockefeller Center, New York, N. Y.

The jacket, called Insulair Vagabond Jacket, has a nylon exterior and a mouton collar and is available in the following colors: navy, charcoal, red, and brown.

The vest, dubbed Insulair Warmster Vest, has a cast vinyl exterior and comes in red or black.

Aircraft Hydraulic Service O-Rings

Aircraft hydraulic service O-rings made of a specially compounded synthetic rubber and intended for an operating temperature range of — 65 to 275° F. have been introduced by Parker Appliance Co., rubber products division, Cleveland, O. The new synthetic rubber formulation, dubbed compound No. 47-671, is basically a nitrile type of rubber designed to meet Government Specification MIL-P-18017, which calls for a rubber of good resiliency and hysteresis characteristics, with no shrinkage and little volume swell in both high- and low-volume swell oils.

Conveyor Belts of Synthetic Fabrics

Two new conveyor belts constructed with synthetic fabric and designed for heavy-duty use on long center and high lift installations have been introduced by Boston Woven Hose & Rubber Co., Boston, Mass. Called Boston High Load and Boston Haul King, the belts have working tension ratings up to 110 pounds per inch per ply and are available with fabrics of either all-rayon or chemically treated cotton warp with nylon filler. The belts are said to have high strength to gage ratios and high strength to weight ratios, resulting in thinner and lighter construction than possible with cotton duck belts of identical numbers of plies.

A booklet reporting test data concerning them, "High Tension Belting," is available from the company.

Bonded Steel-Rubber Chute Lining

Steel-bonded-to-rubber chute lining that can be formed, sawed, sheared, rolled, bent, and punched, and used as a basic construction material on existing or new structures has been placed on the market by The Goodyear Tire & Rubber Co., Industrial Products Division, Akron, O. Called Armaplate, the lining consists of abrasive-resistant rubber and hot-rolled steel and is available in four sheet sizes, 48 by 180 inches, 48 by 144 inches, 36 by 180 inches, and 36 by 120 inches, and in overall gages of ¼-, ½-, ¾, and one inch, including the $\frac{1}{16}$-inch steel plate.

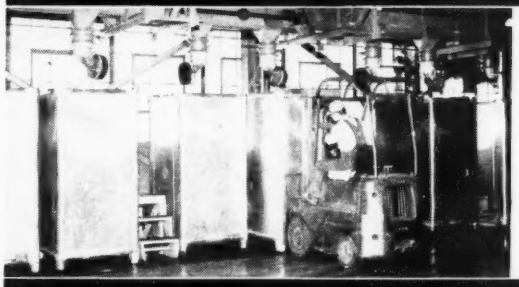
here's how GOODYEAR saved $100,000 and gained flexibility with TOTE* SYSTEM

THE PROBLEM To install at the Goodyear Tire and Rubber Company's plant at Topeka, Kansas, a materials handling system to unload various types of carbon black; provide temporary storage; and make automatic deliveries of carbon black to the Banbury mixers.

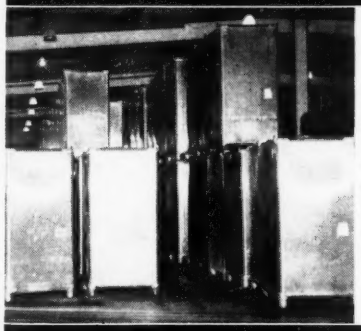
THE SOLUTION Tote System—a **complete** bulk materials handling system, built around aluminum containers plus filling and discharging equipment.

THE RESULT A saving of approximately $100,000 in installation costs (as compared with silos and the necessary conveying equipment), plus greater flexibility.

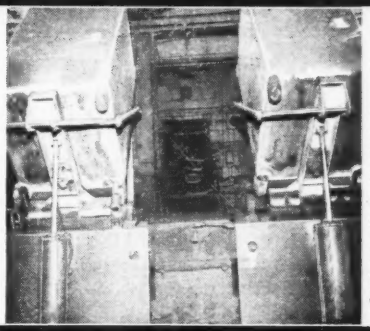
This shows, at right, the railroad hopper car unloading station at the Goodyear plant at Topeka. Three discharge ports at the bottom of the car feed a screw conveyor, which in turn feeds into the bucket elevator just to the left of the car. The elevator feeds a staggered screw conveyor (top of picture) which carries the carbon black into the plant.



This is where the carbon black is discharged into Tote containers (Type A92—92 cubic foot capacity) inside the plant. As the first container in the line is filled, the carbon black is carried over to the second container, and so on down the line until one compartment of the hopper car has been unloaded. A lift truck driver then removes the containers and replaces them with empties.



This is a portion of the warehouse storage space. Tote containers can be double-decked to conserve space.



This is a double Tote Tilt discharge station which feeds two Banburys. Each tilt discharges by gravity onto belt conveyors for delivery to the scale hoppers over the Banburys. The operation is entirely automatic. The operator sets the scale hopper dial for the amount of carbon black wanted, and the belt conveyor runs until the pre-determined amount has been delivered from the Tote containers.

*Tote and Tote System Reg. U S Pat. Off.

Tote System engineers are available to help you determine the savings you can effect with this flexible, economical method of handling bulk materials. Write at once without obligation.

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Since 1935, when Oronite Polybutene was first produced, this important raw material has been widely used in a variety of rubber products. You will find these clear, light colored, chemically inert liquids have a unique tacky property. A technical bulletin giving the physical characteristics and properties of Oronite Polybutenes is available to you on request. Our long experience with Polybutenes is at your disposal—contact the Oronite office nearest you.

TYPICAL TESTS OF ORONITE POLYBUTENES

	No. 24	No. 32	No. 128
Flash Point, Cleveland, °F.	375	385	480
Fire Point, Cleveland, °F.	435	450	570
Pour Point, °F.	20	35	60
Vis. at 100°F., S.S.U.	41,250	121,400	—
Vis. at 210°F., S.S.U.	1,050	2,950	18,620
Viscosity Index	110	118	—
Color, Gardner	1	1	1
Specific Gravity, 60/60°F.	0.90	0.90	0.91
Pounds per Gallon, 60°F.	7.2	7.5	7.6
Molecular Weight, Average (Approx.)	935	1,330	1,500
Acid Number (mg. KOH/gm.)	0.01	0.01	0.01
Carbon Residue, %	None	None	None
Free Sulfur, %	None	None	None
Total Sulfur, %	0.03	0.02	0.02
Organically Bound Chloride (as Chlorine), % by wt.	0.002	0.006	0.007
Inorganic Chlorides & Sulfates, %	None	None	None
Coefficient of Expansion per °C (between 15°C & 100°C)	.00065	.00060	.00061

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20 North Wacker Drive, Chicago 6, Illinois
Mercantile Securities Building, Dallas 1, Texas
Carew Tower, Cincinnati 2, Ohio

Wider Tread Truck Tire

A wider and deeper tread truck tire has been introduced by The General Tire & Rubber Co., Akron, O. Called Super Expressway highway tire, it is said to have a tread 12-15% wider and deeper than the company's Expressway line which it supersedes and is designed with longer shoulder side vents for improved heat radiation. The tire is available in both standard carcass construction and in Nygen cord.

Goodrich Gasoline Tank Hose

Gasoline tank hose, said to be 20% lighter and more flexible than similar hose, has been introduced by The B. F. Goodrich Co., Industrial Products Division, Akron, O. Called Type 82-A, the hose is recommended for tank truck, tank car, and bulk station service and can conduct gasoline, distillate, kerosene, Diesel oil, and other fuel oils.

Dayton Tubed Truck Tire

A tubed, rayon cord truck tire for which increased mileage, cooler performance, and greater driving safety are claimed has been introduced by The Dayton Rubber Co., Dayton, O. Called Thorobred, the tire is said to be 30% stronger than tires of comparable size, and it also is resistant to blowouts, cracking, and tread separation. The improved carcass strength makes for better recapping, the company states. Sizes include 9.00-20, 10.00-20, 10.00-22, 10.3-20, 11.00-20, and 11.00-22.

Quick-Opening Door

(*Continued from page 114*)

entry for cleaning and inspection, but also applicable to autoclaves, sterilizers, and rubber industry vulcanizers, has been placed on the market by The Patterson-Kelly Co., Inc., East Stroudsburg, Pa. Called p-k Lever-Lock Door, it is locked and unlocked by means of bars, as opposed to normally bolted exchanger doors, and takes five seconds to operate, according to the company.

Temperature range is from —70° to 400° F. and pressure range is from full vacuum to 300 psi.

Kel-F Acids

(*Continued from page 116*)

According to the company, possible uses for the materials include the role of rubber accelerators, anti-oxidants, and stabilizers, as promotors for two-phase reactions, additives for metal treating baths, insecticidal dispersants, gelling agents for printing inks and lubricating greases, and chemical intermediates. Metallic salts, esters, acid halides, alcohols, amides, nitriles, and ketones have been prepared from these Kel-F Acids.

PX-220 Diiso Decyl Adipate

A plasticizer designed for vinyl formulations requiring high-temperature processing cycles or low-temperature flexibility has been placed on the market by Pittsburgh Coke & Chemical Co., Pittsburgh, Pa. A diiso decyl adipate designated PX-220, the plasticizer is said to offer a combination of low specific gravity, high permanence, very low volatility, and excellent low-temperature properties in polyvinyl chloride formulations. PX-220, in combination with other plastizers, is suitable for use in such products as upholstery stocks, garden hose, tubing, gasketing, and electrical insulation, according to the company.

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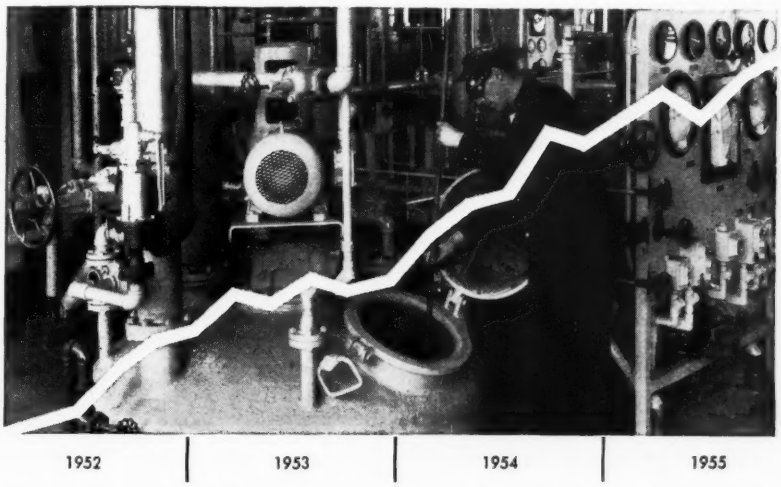
INTERMEDIATE & RUBBER CHEMICALS DEPARTMENT
BOUND BROOK, NEW JERSEY



The mounting demand for Cyanamid's delayed-action accelerators is reflected in the consumption chart superimposed on the above photograph, which shows the extraction of a sample of NOBS Accelerator for a quality-control check.

Furnace Blacks Effect Major Change in Tire Processing

With the growing use of furnace blacks in automobile tire compounding, a major change in formulations has been necessary. Where formerly channel blacks worked well with thiazole-type accelerators, furnace blacks required something new—a delayed-action accelerator that would prevent scorching, premature cure and other processing difficulties.

To answer this problem, Cyanamid's Research Laboratories at Stamford, Conn., developed two products, NOBS* No. 1 and NOBS* SPECIAL delayed-action accelerators. Both have proved so successful in use that they have set standards of performance which many manufacturers now use as guides for measuring safe processing time. In addition, their acceptance has been so rapid that production capacity at Bound Brook has been expanded several times to meet demand.

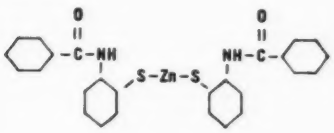
Reinforcing furnace blacks create higher processing temperatures and their alkalinity prematurely activates the thiazole-type accelerator. In mixing and processing, formulations containing delayed-action accelerators, such as NOBS No. 1 provide sufficient safe handling time to overcome the inherent scorching tendencies of furnace blacks.

The delayed action of NOBS No. 1 and NOBS SPECIAL Accelerators enables rubber manufacturers to reduce losses on scorched stock, allows increased extruding speeds and improves mixed stocks storage stability. During the first minutes of the cure improved mold-flow completely fills out the design, reducing tendency for surface blemishes.

*Trade-mark

A New Low-Temperature Peptizer

An excellent chemical peptizer for low-temperature mastication of natural rubber is Pepton® 65 Plasticizer, newest addition to Cyanamid's growing line of rubber chemicals. Its chemical structure is:



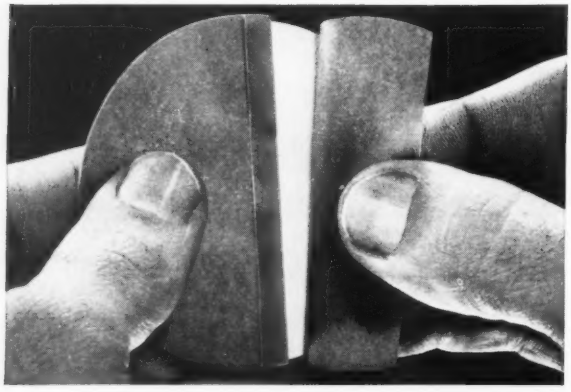
Zinc 2-Benzamidothiophenate

Extensive laboratory tests and factory evaluation have established that the use of small quantities of Pepton 65 will allow a reduction of as much as 30% in milling cycle and will impart good plasticity to masticated rubber. Reports further show that the milling cycle can be held constant and the Mooney viscosity of the rubber substantially reduced. This first advantage is of special interest to companies which are limited in their milling and mixing capacity. The second is especially welcome in factories processing soft rubber for products such as blown sponge.

Pepton 65 shows promise as an additive in the initial stages of direct mix Banbury batches. Its activity at low temperatures gives catalytic aid to the rubber mastication immediately, instead of requiring activation by the higher temperatures reached during Banbury mixing.

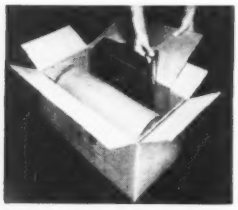
Inquiries about this new product are invited, and a trial sample will be forwarded promptly on request.

New Patapar Releasing Parchments



Better release...lower cost

The new releasing types of Patapar Vegetable Parchment have characteristics which make them ideal as a protective backing for pressure sensitive surfaces, separator sheets for uncured rubber, rubber tape, and as a wrapping material for tacky substances.



Effective separator sheet for uncured, natural, or synthetic rubbers

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- Excellent release from tacky surfaces
- Releasing qualities remain constant as time passes
- High resistance against penetration or migration of rubber softeners
- Pressure sensitive surfaces retain full effectiveness
- Low cost

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TECHNICAL BOOKS

BOOK REVIEWS

"Dielectric Behavior and Structure." Charles Phelps Smyth. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York, N. Y. Cloth, 6¼ by 9½ inches, 451 pages. Price, $9.00.

The overall purpose of the work is to explain the relation between the molecular structure of matter and its dielectric behavior, using experimental measurements of dielectric constant and loss and electric dipole moment. Highly theoretical in nature, the book should be of considerable interest to research chemists, physicists, and engineers.

Fundamental theories are discussed, and results of experiments with a large number of liquids and solids are described in detail. The use of dipole moment in the determination of molecular structure and in the nature of the chemical bond, resonance, and intramolecular energy is treated at length.

"Information Processing Equipment." Edited by M. P. Doss. Reinhold Publishing Corp., New York, N. Y. 270 pages. Price, $8.75.

A compilation of the papers presented at the American Chemical Society's September, 1953, symposium on "Equipment for the Preparation, Reproduction, and Utilization of Technical Information," this volume contains ten chapters covering latest developments in such informational media as electric and automatic typewriters, calculating machines, stencil and hectographing equipment, collating machines, lensless copying with sensitized paper, industrial photography, microcopying, letterpress and offset printing, dictating and recording machines, punched cards, and machines for handling numerical data. Equipment and techniques are abundantly illustrated.

"Chemical Engineering Materials." Frank Rumford. Chemical Publishing Co., Inc., New York, N. Y. Cloth, 5½ by 9 inches, 382 pages. Price, $7.50.

This reprint of an English text takes as its scope the materials used in the construction, equipment, and maintenance of chemical plants and is planned to satisfy the needs of both chemical and mechanical engineers who work together in the design and operation of these plants. The student, too, will find this a valuable addition to his library, although he may sometimes find himself in over his head.

Two chapters on the mechanism of corrosion and the testing of materials precede the chapters devoted to the study of such construction materials as plastics and rubber, cast iron, steel, ferrous alloys, lead, copper, silicon iron, precious metals, organic and inorganic cements, vitreous silica and hard glass, and others. An appendix lists the resistance of common metals to specific chemicals and the mechanical properties of construction materials. Tables and illustrations enhance the value of the book, and literature references point the way to further study.

NEW PUBLICATIONS

"Design File: Rubber-Phenolics." General Electric Co., chemical & metallurgical division, Pittsfield, Mass. 32 pages. Intended for the design engineer, this publication reports the design advantages of G-E rubber-phenolics, compares rubber-phenolics with conventional phenolics, and describes 25 case histories of how the use of rubber-phenolics for industrial parts solved perplexing production problems.

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For example, Santocure NS, the newest Monsanto accelerator of the sulfenamide type, is characterized by even more delayed action, greater strength and full activity at curing temperatures. As an analogue of regular Santocure it is designed to meet the needs of present-day high-speed production which involves high processing temperatures.

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Santowhite MK
Santowhite L
Santowhite Powder

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Santocure
El-Sixty*
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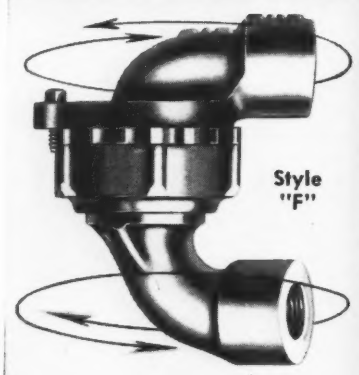

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Publications of The Goodyear Tire & Rubber Co., chemical division, Akron, O.:

"Resins of Renown." 6 pages. Photographs of applications and some technical data on the firm's Pliovic vinyl resins and Plio-Tuf modified styrene resins are presented in this booklet.

"Properties: Plio-Tuf C75 for Calendering." 55-192. 2 pages. The physical, chemical, and electrical properties of Plio-Tuf C75 and its application to the manufacture of thermoplastic calendered sheets for post-forming are reported here.

"Calendering and Laminating Plio-Tuf." 55-193. 4 pages. The techniques of calendering and laminating Plio-Tuf high-impact modified styrene resins are discussed in this publication.

"Compounding Plio-Tuf C75 for Calendering." 55-194. 2 pages. The compounding of this material, including suggestions on the use of colors, fillers, and extenders, is outlined in this bulletin.

Publications of E. I. du Pont de Nemours & Co., Inc., elastomers division, Wilmington, Del.:

"Neoprene Innerliners for Tubeless Tires." M. F. Torrence and W. J. Schrantz. BL-296. 6 pages. Recipes for all-neoprene, neoprene-natural rubber, and Neoprene W-GR-S 1500 blend innerliner stocks for tubeless tires, together with physical properties of these stocks, are reported.

"Solution Coatings of 'Hypalon' Chemical Rubber." K. C. Smith, I. D. Roche, and L. M. Magner. BL-297. 16 pages. Recipes and compounding suggestions for making "Hypalon" decorative or protective coatings for rubber, wood, fabric, concrete, and metal are contained in this report.

"Neoprene Solvent Cements." Louis S. Bake. Report No. 55-4. 42 pages. Information on the preparation and properties of neoprene solvent cements for adhesive use is discussed in this bulletin, including the suitability of various types of neoprene and the modifying effects on them of important compounding ingredients, and practical formulae for solvent-type adhesives.

"Neoprene Notebook." No. 65. 8 pages. This issue of the "Notebook" contains articles on the weathering and sunlight resistance of neoprene compared to natural rubber, a new design for a neoprene power transmission belt, neoprene soles for industrial shoes, the Navy's neoprene life raft, neoprene agricultural hose, and other items.

"Facts about 'Hypalon.'" No. 2. 2 pages. The heat resistance of "Hypalon" and an industrial case history illustrating this property are discussed in this issue.

"Silastic Newsletter." Vol. III, No. 3. Dow Corning Corp., Midland, Mich. 5 pages. Among the subjects discussed in this issue are the use of Silastic 152 for exposure to 600° F. temperatures, typical properties of Silastic 50 and Silastic 80 obtainable with various cures, and the techniques for the low-temperature testing of certain Silastic stocks.

"Silastic Facts." Reference 9-359. 2 pages. Silastic 675, an extreme-temperature, low compression set, low shrink stock, is discussed in this issue, with typical properties before and after curing reported.

"Silastic Fabricators." Reference 9-903. 4 pages. Included here are a résumé of the advantages of Silastic fabricated parts and a listing of independent fabricators, arranged by states.

"The Tensile Strength of Elastomers." G. R. Taylor and S. R. Darin. Mellon Institute, Pittsburgh, Pa., 15 pages. This excerpt from Vol. XVII of the *Journal of Polymer Science*, available through the Institute, proposes a theory of tensile strength of amorphous polymers which describes the effect of the degree of cross-linking on strength. The theory is shown to be good for GR-S and semi-quantitatively correct for a crystallizable polymer, 5° C. polybutadiene.

"Thiophene." Catalog 55-2. Sharples Chemicals Division, Pennsylvania Salt Mfg. Co., Philadelphia, Pa. 16 pages. The physical and chemical properties, chemistry, and applications of thiophene, a heterocyclic sulfur compound, and its derivatives are contained in this booklet. The commercial availability of thiophene from Sharples on a continuing dependable basis is expected to encourage renewed activity with this material useful in the rubber and plastics fields.

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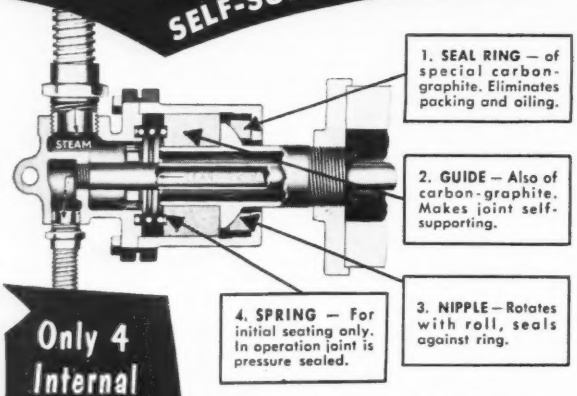
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"Chemical Resistance of Enjay Butyl." Enjay Co., Inc., New York, N. Y. 8 pages. Resistance of the company's butyl rubber to acids, bases, solvents, and animal and vegetable oils is discussed and illustrated through laboratory test data in this addition to the "Enjay Butyl Manual."

"Farrel-Birmingham Flood Report." Bulletin No. 60. Farrel-Birmingham Co., Inc., Ansonia, Conn. 12 pages. This is a photographic account of the damage sustained by the company's Ansonia and Derby plants in the recent New England flood and the post-mortem efforts to get production back to normal.

"Acrylic Esters." Bulletin F-7434. Carbide & Carbon Chemicals Co., division of Union Carbide & Carbon Corp., New York, N. Y. 8 pages. Physical and chemical properties, chemical reactions, methods of polymerization, and applications of the firm's ethyl acrylate, n-butyl acrylate, 2-ethylbutyl acrylate, and 2-ethylhexyl acrylate are discussed in this publication.

"Look to Linde for Silicones." Linde Air Products Co., division of Union Carbide & Carbon Corp., New York, N. Y. 4 pages. Descriptions of the various silicones made by the company appear in this folder.

"Indonex Plasticizers in Molded Bumper Compounds." Circular 13-52. Indoil Chemical Co., Chicago, Ill. 8 pages. Recipes for natural and synthetic rubber bumper compounds employing the firm's plasticizers are contained in this publication, together with the physical properties of these compounds after curing

"'4000' Series: Color Paste Concentrates for Coloring Polyester Resins." Technical bulletin No. 160. Claremont Pigment Dispersion Corp., Brooklyn, N. Y. 2 pages. Technical data and compounding suggestions are given.

"Powerduct Cables." Anaconda Wire & Cable Co., New York, N. Y. 4 pages. Descriptions and tabular data of the firm's Duracord and Densheath type of cables for flexible bus-drop power distribution are included in this folder.

"Hardness or Density of Rubber Roll Coverings." Report No. 7. Rodney Hunt Machine Co., Orange, Mass. 2 pages. A discussion of the three commonly used standards of rubber density, plastometer, densimeter, and durometer, and the instruments employed to determine them, are covered in this folder.

"Occupational Safety Services." Service Guide 2.1. National Safety Council, Chicago, Ill. 68 pages. This is a catalog of the variety of accident prevention aids available from the Council, including posters, films, booklets, safety talks, and regular publications.

"New Automatic Grease Monkey." Bulletin A-2406. Reliance Electric & Engineering Co., Cleveland, O. 4 pages. This brochure describes and illustrates the company's Metermatic prelubricated bearing design that has a metering plate which automatically regulates grease flow.

"Thickening and Gelling Organic and Aqueous Systems with Permagel." Bulletin SD-30. Minerals & Chemicals Corp. of America, Metuchen, N. J. 7 pages. Formulations for gelling or thickening a wide range of liquids, such as latex, ethyl alcohol, dioctyl phthalate, butyl stearate, and water, through the use of Permagel, the firm's Attapulgus-type colloidal fuller's earth, are contained in this bulletin, together with recommended procedures.

"Questions and Answers on Electron Microscopes." North American Philips Co., Inc., research and control instruments division, Mt. Vernon, N. Y. 8 pages. This booklet presents information on electron microscopes generally and the company's models in particular in the form of questions and answers.

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MARKET REVIEWS

Natural Rubber

COMMODITY EXCHANGE
WEEK-END CLOSING PRICES

Futures	July 23	Aug. 20	Aug. 27	Sept. 3	Sept. 10
Sept.	42.30	46.30	46.50	49.00	49.85
Dec.	41.35	45.60	45.83	48.20	48.45
1956					
Mar.	40.40	44.25	44.65	46.85	47.00
May	39.40	43.10	43.40	45.75	45.60
July	38.15	41.80	42.15	44.30	44.20
Sept.	37.15	40.70	40.95	43.10	43.00
Total weekly sales, tons	16,340	25,000	9,640	7,810	11,140

The price of natural rubber continued its inexorable climb during the period from August 16 to September 15. R.S.S. #1 reached the 50½¢-a-pound level at period's end, the highest price since free trading was resumed in 1947. The volume of trading on the New York Commodity Exchange fell off somewhat from last period's total; 6,255 lots were sold, against the record 7,990 lots in the preceding period.

Prediction of such continuing price increases was made in these columns last month, and there is now nothing in the wind to suggest that these increases will halt in the near future.

The causes of this period's price rise are essentially the same as last period's: record industrial production, under-estimation of rubber requirements, the stationary level of plantation output, and continued strong purchasing by the Soviet Union, Red China, and the Communist satellites. On the latter, for example, it has been reported that Poland bought 7,399 tons of rubber from Malaya during the first seven months of this year, against 6,224 tons in the same months of 1954; while the Soviet Union had bought 10,000 more tons in July alone on orders through London and Amsterdam.

Placing the onus for spiraling prices on speculators in crude rubber futures, W. S. Richardson, Goodrich president, recently urged that margin requirements on the New York Commodity Exchange be increased. Quoting 23¢-a-pound as a fair price for crude rubber, he suggested that the United States Government regulate these margin requirements, as is done on the New York Stock Exchange.

Replying to these assertions, Theodore A. Lauer, president of the Commodity Exchange, Inc., New York, denied that there is any manipulative activity in crude rubber futures and defended the speculator as a necessary risk bearer for the hedger, serving to create a more liquid market.

Returning to statistical details for the period under consideration, on the New York Commodity Exchange, sales for the second half of August were 32,450 tons, bringing the monthly total to 78,590 tons. Sales during the first half of September were 30,100 tons, 62,550 tons for the period.

Near-September stocks began the period at 45.95¢ and came to an end at 49.85¢ on September 9. Near-December stocks began at 45.15¢ and concluded the period at 49.10¢.

On the physical market, R.S.S. #1 began the period at 46.13¢ a pound, fell to a period low of 44.74¢ on August 18, and climbed with reasonable steadiness to the period high of 50.50¢ on September 14 and 15.

August monthly average spot prices for representative grades follow: R.S.S. #1, 46.37¢; R.S.S. #3, 45.72¢; #3 Amber Blankets, 39.34¢; and Flat Bark, 37.59¢. For the first half of September, R.S.S. #1 averaged 49.38¢.

NEW YORK SPOT MARKET
WEEK-END CLOSING PRICES

	July 23	Aug. 20	Aug. 27	Sept. 3	Sept. 10
R.S.S.: #1	42.38	46.38	46.50	49.00	50.00
2	41.88	46.13	46.50	48.63	49.75
3	41.38	45.88	45.88	48.25	49.25
Latex Crepe					
#1 Thick	44.00	48.38	47.75	50.13	52.13
Thin	44.00	48.38	47.75	50.13	52.13
#3 Amber Blankets	37.50	39.00	38.00	39.63	40.38
Thin Brown Crepe	37.25	38.75	37.75	39.25	40.00
Flat Bark	34.88	38.00	36.50	37.50	38.50

Synthetic Rubber

A look at the current status of GR-S type styrene rubbers and latices reveals that they are still in short supply, despite the fact that production facilities are operating at maximum capacity. Cognizant of the situation, such producers of these rubbers as Firestone and Goodyear have announced their intention to expand their facilities substantially, and to these may be added Goodrich-Gulf Chemicals, which more recently reported that it is studying engineering surveys that may lead to a major expansion program in the near future. Goodrich-Gulf has also indicated production diversification in announcing that it will begin to produce 1,000,000 pounds of styrene latices a month.

So far there have been no major breaks in the price structure of the industry. Pressure is probably strongest for price increases of special types of styrene rubber latices which provide replacement for much higher priced natural latices used in making foam sponge.

Private operation of the synthetic rubber industry has so far produced only three new grades of styrene rubber. Phillips Chemical Co. is offering type 1803, an oil-black masterbatch, and Naugatuck Chemical has been marketing type 1551, a cold rubber containing Polygard stabilizer, and type 1061, a hot rubber also containing Polygard.

The new subcommittee 13 on synthetic elastomers of Committee D-11 of the American Society for Testing Materials has meanwhile been hearing expressions of views from both producers and consumers of styrene rubbers on the possibility of re-instituting past government practices of coding, type descriptions, specifications, and methods of testing. In general, consumers approve of these practices; while producers are dubious of their value in encouraging the growth of the industry. The subcommittee itself will soon express its opinion, which will have a bearing on future trends of both the industry and the consumer market.

Latex

Activity in *Hevea* and synthetic latices during the period from August 16 to September 15 was quiet as consumers seemed to be postponing the replenishment of their stocks as long as possible in the hope that prices would ease. Observers say that this attitude has been encouraged by the willingness of producers to meet the few inquiries that have been forthcoming.

Stocks of natural latex were said to be still short, but somewhat better than the previous month's. GR-S stocks, however, were apparently in serious need of replenishment.

Prices of natural and synthetic latices during the period were about the same as last month's, despite the still-mounting price levels of natural rubber. Average spot quotations were: *Hevea* latex, 42⅞¢ per pound solids; GR-S, 26-32.3¢; neoprene, 37-47¢; and N-type, 46-54¢.

Final June and preliminary July domestic statistics for all latices follow:

(All Figures in Long Tons, Dry Weight)

Type of Latex	Production	Imports	Consumption	Month-End Stocks
Natural				
June	0	7,736	6,589	9,788
July	0	——	5,487	11,938
GR-S				
June	4,635	53	4,885	6,645
July	4,732	30	3,932	6,906
Neoprene				
June	905	0	722	817
July	641	0	552	806
Nitrile				
June	1,434	0	587	883
July	993	0	404	1,129

Scrap Rubber

Fairly good activity characterized the scrap rubber market during the period from August 16 to September 15 despite Naugatuck's temporary retirement from the market early in the period because of the severe flood damage it had sustained.

Smooth

is the word for rubber compounds containing

POLYMEL DX

POLYMEL DX is a medium soft, friable, polystyrene-type resin, amber-to-brown in color but with no coloring properties. It functions as a plasticizer and dispersing aid in natural and synthetic rubber compounds. The use of from 5 to 35 parts on the rubber, depending on the loading of the compound, imparts the highly desirable, smooth working quality so necessary for efficient tubing.

POLYMEL DX lends a lubricating action to extrusion compounds, thus permitting high speed operation. With correct die heat and pressure, POLYMEL DX stocks have a fine surface finish and retained outline in the uncured state. POLYMEL DX is useful in practically all extruded goods, including wire insulation compounds. POLYMEL DX functions particularly well in highly loaded compounds.

Send today for your sample of this versatile resin, available either in powder or 2″ lump form.

Prices fob Baltimore		
	1 drum to 4900 lbs.	— .1475¢ lb.
	5000 lbs. to truckloads	— .1425¢ lb.
	Truckloads	— .1375¢ lb.

THE POLYMEL CORPORATION

MANUFACTURERS OF
compounding ingredients for reinforcing, plasticizing, extending and processing natural and synthetic elastomers.

Plaza 2-1240 — 1800 BAYARD ST., BALTIMORE 30, MD.

By period-end Naugatuck was receiving shipments by truck, with scrap deliveries by rail expected soon. Optimism prevailed for the coming September-October period.

According to the Bureau of the Census, United States Department of Commerce, May exports of scrap rubber rose from the April figure of 3,502,808 pounds to 4,124,819 pounds; the dollar value of these exports, however, declined from $143,990 to $133,436. Largest foreign purchasers, in order, were Spain, Western Germany, Canada, Mexico, and Japan.

Imports of scrap rubber rose to 1,404,732 pounds, valued at $47,947 in May, from April's 1,088,687 pounds, valued at $28,501.

Mixed auto tires generally rose $1 per ton at both Akron and Eastern points. Other prices remained the same.

	Eastern Points	Akron, O.
	(Per Net Ton)	
Mixed auto tires	$12.00/15.00	$15.00/16.00
S. A. G. auto tires	Nom.	13.00
Truck tires	Nom.	14.00
Peelings, No. 1	41.00/42.00	41.00/42.00
2	24.00	24.00
3	15.50	Nom.
Tire buffing	17.00	14.00/15.00
	(¢ per Lb.)	
Auto tubes, mixed	4.50	4.50
Black	5.25/5.50	5.25/5.50
Red	7.00	7.00
Butyl	6.00/6.50	6.25/6.50

Reclaimed Rubber

The reclaimed rubber market recovered from the traditional summer lull during the period from August 16 to September 15, with indications strong that business would improve still further during the period ahead.

According to the Bureau of the Census, United States Department of Commerce, May exports of reclaimed rubber declined to 2,365,697 pounds, valued at $216,762, from April's 2,436,914 pounds, worth $221,467. Canada was by far the largest purchaser, with Venezuela a poor second. April reclaimed rubber imports were quoted at 311,115 pounds, value $16,751. No import figures for May were available.

According to the Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce, domestic consumption of reclaimed rubber during July totaled 22,684 long tons; production was 24,038 long tons, and July-end stocks were 29,811 tons.

The price of butyl reclaim rose 1¢ a pound over the last period considered.

RECLAIMED RUBBER PRICES

	Lb.
Whole tire: first line	$0.10
Fourth line	.0875
Inner tube: black	.15
Red	.21
Butyl	.16
Pure gum, light colored	.23
Mechanical, light colored	.135

The above list includes those items or classes only that determine the price basis of all derivative reclaim grades. Every manufacturer produces a variety of special reclaims in each general group separately featuring characteristic properties of quality, workability, and gravity at special prices.

Cotton Fabrics

Trading was reasonably active on the industrial fabrics market during the period from August 16 to September 15, despite the caution auto manufacturers are showing in the purchase of wide industrial fabrics until requirements for the 1956 models are definitely ascertained. Trading was most noticeable in wide drills and wide sheetings. Wide drills, particularly the 59-inch, 1.85-yard fabric, sold in sizable yardages for delivery in the fourth quarter, with prices tending to edge up. Wide sheetings were in heavy demand for quick and nearby delivery, but the scarcity of these goods reduced the potential sales volume.

Observers agree that as soon as 1956 automobile models are past the planning stage, the market will show vast improvement, particularly in wide industrial fabrics.

Market averages were slightly above last month's, with most increases limited to drills and sheeting. Period-end prices follow.

COTTON FABRICS

Drills		
59-inch 1.85 yd.	*yd.*	$0.39/$0.395
2.25-yd.		.33/.335
Ducks		
38-inch 1.78-yd. S.F.	*yd.*	nom.
2.00-yd. D.F.		nom.
51.5-inch, 1.35-yd. S.F.		nom.
Hose and belting		.67
Raincoat Fabrics		
Printcloth, 38½-inch, 64x60, 5.35-yd	*yd.*	.1425
6.25 yd.		.12
Sheeting, 48-inch, 4.17-yd.		.20
52-inch, 3.85-yd.		.235
Osnaburgs		
40-inch 2.11-yd.	*yd.*	.26
3.65-yd.		.1625
Chafer Fabrics		
14.40-oz./sq. yd. Pl.	*yd.*	.70
11.65-oz./sq. yd. S.		.61
10.80-oz./sq. yd. S.		.6575
8.9-oz./sq. yd. S.		.67
Other Fabrics		
Headlining, 59-inch, 1.65-yd., 2-ply	*yd.*	.465
64-inch, 1.25-yd., 2-ply		.595
Sateens, 53-inch, 1.32-yd.		.56
58-inch, 1.21-yd.		.61

Rayon

Total calculated production of rayon and acetate yarn during August was 74,000,000 pounds, of which 35,200,000 pounds were regular-tenacity yarn and 38,800,000 pounds were high-tenacity yarn. These figures represent increases over July figures.

Total shipments for August were 73,900,000, as compared with 66,400,000 pounds shipped in July. These shipments consisted of 39,000,000 pounds of rayon high-tenacity yarn, the highest monthly total since July, 1953, when 39,900,000 pounds were shipped; and 34,900,000 pounds of regular-tenacity yarn, 13% above the 30,800,000 pounds shipped in July, but only 3% above August, 1954, shipments.

Month-end stocks were as follows: total yarn, 46,400,000 pounds, compared to July's 46,300,000 pounds; regular-tenacity yarn, 41,200,000 pounds, compared to July's 40,900,000 pounds; and high-tenacity yarn, 5,200,000 pounds, a mere three days' supply and far below the 19,100,000 pounds in reserve a year ago.

Prices per pound of rayon tire yarns and fabrics were unchanged.

RAYON PRICES

Tire Yarns	
High Tenacity	
1100/ 480	$0.62
1100/ 490	.62
1150/ 490	.62
1165/ 480	.63
1230/ 490	.62
1650/ 720	.61
1650/ 980	.61
1875/ 980	.61
2200/ 960	.60
2200/ 980	.60
2200/1466	.67
4400/2934	.63
Super-High-Tenacity	
1650/ 720	.64
1900/ 720	.64
Tire Fabrics	
1100/490/2	0.72
1650/980/2	.695 / $0.73
2200/980/2	.685

Nuclear Congress

(Continued from page 88)

nator of the event. More than 2,000 representatives of industry, government, and education are expected to attend, as well as members of 25 national science and engineering societies.

An Atomic Exposition will run concurrently with the conclave, supplementing and illustrating the discussions. Sponsored by the American Institute of Chemical Engineers, one of the Engineers Joint Council's 10 constituent and associate societies, the Exposition will display atomic reactors, component parts, equipment, materials, and services performed, including nuclear equipment never shown before, the Council declares.

Thorndike Saville, president of the Council, summed up the purpose of the Conference as "the communication of ideas and developments among the many thousands of persons in industry, business, agriculture, and medicine, for whom the technology of the atom is increasingly important."

The sponsoring groups coordinated by the Council and its societies involve 500,000 engineers and scientists representing such diverse fields as chemical, petroleum, steel, non-ferrous metals, aviation, mining, metallurgy, electronics, automobile manufacturers, rockets, and road construction.

Further details may be obtained from the Engineers Joint Council, 29 W. 39th St., New York 18, N. Y.

Monsanto Chemical Co., organic chemicals division, has announced a 3¢-per-pound price reduction on its HB-40, an extender-type plasticizer for plastisols, as well as a secondary plasticizer in polyvinyl chloride formulations.

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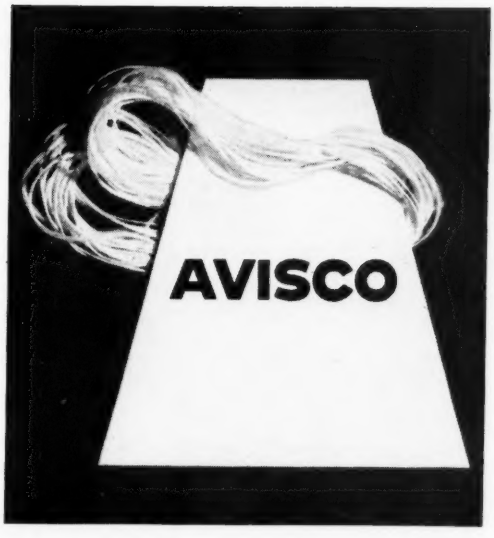

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STATISTICS of the RUBBER INDUSTRY

U.S.A. Imports and Production of Natural (Including Latex and Guayule) and Synthetic Rubber (in Long Tons)

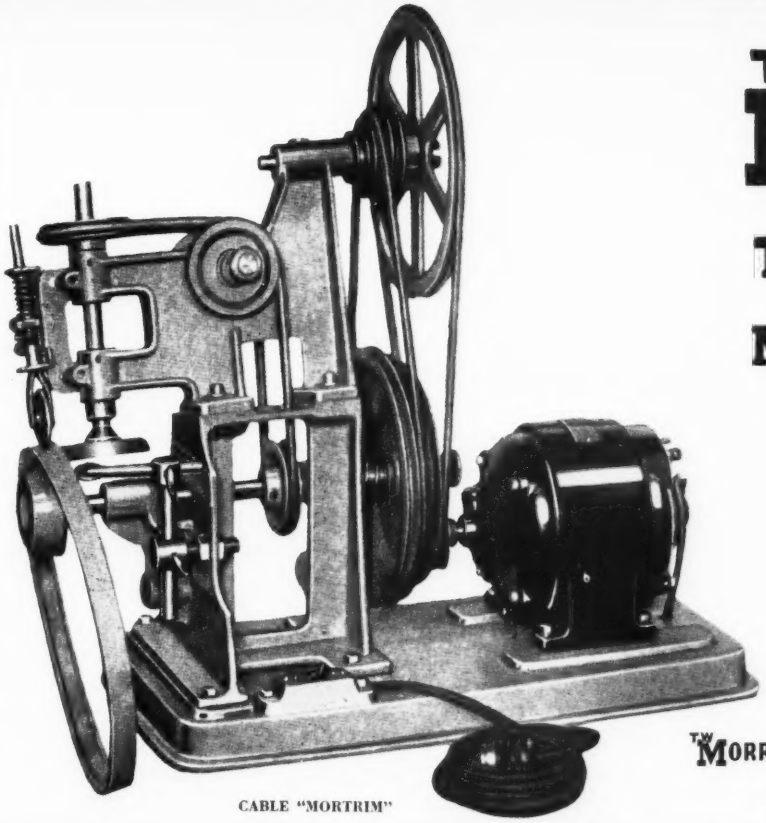
Year	Natural	GR-S	S-Types	Butyl	Neoprene	N-Type	Total Natural and Synthetic
1945	135,672	717,693	7,163	52,378	45,672	7,871	966,449
1946	400,687	612,687	721	80,823	47,766	5,738	1,148,422
1947	688,354	405,496	3,362	62,824	31,495	6,618	1,198,149
1948	735,227	390,240	15,252	56,662	34,848	7,012	1,239,241
1949	660,792	288,882	21,717	54,046	35,215	11,072	1,071,724
1950	802,249	350,801	28,086	60,915	50,067	12,037	1,304,155
1951	733,048	694,583	9,946	76,475	58,907	15,333	1,588,292
1952	805,997	636,969	17,885	81,630	65,745	16,228	1,624,454
1953	647,615	668,386	12,342	79,801	80,495	20,198	1,508,837
1954							
Jan.	47,170	43,524	853	5,539	6,513	1,620	105,219
Feb.	42,645	40,661	1,030	4,801	6,206	1,574	96,917
Mar.	47,721	43,372	1,092	5,214	5,190	1,900	104,489
Apr.	49,855	34,384	1,167	6,004	5,601	1,645	98,656
May	55,983	35,117	1,120	4,581	4,828	1,960	103,589
June	66,698	35,829	1,263	3,182	5,101	1,696	113,769
July	40,614	35,415	1,388	4,960	4,673	1,814	88,864
Aug.	59,124	36,843	1,803	5,003	5,313	1,624	109,710
Sept.	48,618	38,937	2,183	4,675	6,036	1,718	102,167
Oct.	49,432	42,000	1,938	5,117	6,644	1,864	106,995
Nov.	45,474	41,109	2,021	5,060	6,839	1,913	102,416
Dec.	43,557	45,507	1,849	4,666	6,206	2,068	103,853
Total	596,848	472,698	17,707	58,802	69,150	21,396	1,236,601
1955							
Jan.	49,941	57,607	1,436	3,220	6,983	2,099	121,286
Feb.	50,880	55,293	1,149	3,727	6,910	1,729	119,688
Mar.	61,250	63,940	1,229	5,256	7,132	2,158	140,965
Apr.	61,113	50,745	10,081	5,148	8,359	2,534	137,980
May	61,042	3,592	63,235	5,115	7,852	3,122	143,958
June	52,762	3,739	61,628	3,872	5,919	3,850	131,770
July*	....	1,640	65,187	5,395	6,904	3,700	....

Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.

U.S.A. Consumption of Natural (Including Latex) and Synthetic Rubber (Long Tons)

Year	Natural	GR-S	S-Types	Butyl	Neoprene	N-Type	Total Natural and Synthetic
1945	105,429	598,434	1,711	43,012	42,394	8,029	799,009
1946	277,597	631,405	721	79,228	44,357	5,988	1,039,296
1947	562,661	446,316	2,273	68,838	37,703	4,536	1,122,327
1948	627,332	334,233	11,080	58,870	32,118	5,771	1,069,404
1949	574,522	299,420	21,717	52,664	31,753	8,827	988,903
1950	720,268	388,427	27,803	66,348	43,781	11,930	1,258,557
1951	454,015	617,200	9,244	70,500	48,887	13,066	1,212,912
1952	453,846	648,816	17,604	71,229	55,522	13,866	1,260,883
1953	553,473	611,748	12,433	77,826	65,900	16,929	1,338,309
1954							
Jan.	46,960	37,707	982	5,438	4,774	1,272	97,133
Feb.	46,897	36,765	942	5,696	4,467	1,190	95,957
Mar.	53,709	42,074	1,062	6,300	5,177	1,447	109,769
Apr.	51,451	40,194	1,130	6,241	4,684	1,395	105,105
May	51,398	40,030	1,144	5,602	4,486	1,366	104,026
June	54,253	43,782	1,192	5,961	4,769	1,491	111,448
July	37,894	31,474	1,326	4,108	3,499	1,145	79,446
Aug.	38,069	30,800	1,596	3,569	4,647	1,439	80,120
Sept.	52,412	40,204	1,994	5,138	5,049	1,493	106,290
Oct.	55,970	45,002	2,061	4,711	4,931	1,604	114,279
Nov.	53,326	44,429	1,980	3,967	5,276	1,635	110,613
Dec.	55,096	50,540	1,935	4,583	5,434	1,638	119,226
Yr.-end adj.	− 1,150	....	....	+ 150	....	+ 600	....
Total	596,285	483,001	17,344	61,464	57,203	17,715	1,233,412
1955							
Jan.	56,911	54,728	1,643	4,478	5,676	1,854	125,290
Feb.	50,997	54,707	1,293	4,312	5,476	1,826	118,611
Mar.	58,472	62,548	1,189	4,839	6,423	2,119	135,590
Apr.	52,963	54,091	5,655	4,321	5,884	2,095	125,009
May	54,746	2,533	60,325	4,455	6,143	1,953	130,155
June	56,282	3,666	62,226	4,704	6,320	2,566	135,764
July*	46,357	2,690	50,631	3,909	4,339	1,656	109,582

* Preliminary.
Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.



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U.S.A. Stocks of Latex

(Long Tons, Dry Weight)

Year	Natural	GR-S	Neoprene	N-Type	Total Synthetic	Total Natural & Synthetic
1944	2,443	....	....	....	....	2,443
1945	3,121	....	....	....	....	3,121
1946	4,865	....	....	....	....	4,865
1947	5,033	....	....	....	....	5,033
1948	11,235	....	....	....	....	11,235
1949	5,063	....	....	....	....	5,063
1950	4,927	....	....	....	....	4,927
1951	4,752	3,727	1,245	532	5,504	10,256
1952	6,201	5,040	1,019	902	6,961	13,162
1953	13,532	4,794	1,117	721	6,632	20,164
1954						
Jan.	12,375	5,001	1,019	703	6,723	19,098
Feb.	13,963	5,269	963	625	6,857	19,820
Mar.	11,870	5,247	975	588	6,810	18,680
Apr.	10,803	5,273	1,062	600	6,935	17,738
May	8,907	5,180	1,110	655	6,945	15,852
June	9,460	5,591	1,020	646	7,257	16,717
July	10,171	5,363	1,004	831	7,198	17,369
Aug.	12,009	4,220	1,019	993	6,232	18,241
Sept.	11,546	4,504	984	908	6,396	17,942
Oct.	10,952	4,745	1,001	950	6,696	17,648
Nov.	9,759	4,943	1,055	939	6,937	16,696
Dec.	11,133	5,134	1,087	811	7,032	18,165
1955						
Jan.	9.684	5,861	1,067	812	7,740	17,424
Feb.	8,619	5,753	879	663	7,295	15,914
Mar.	7,820	6,940	909	637	8,486	16,306
Apr.	6,790	7,098	786	703	8,587	15,377
May	8,854	7,021	767	817	8,605	17,459
June	9,788	6,645	817	883	8,345	18,133
July*	11,938	6,906	806	1,129	8,841	20,779

* Preliminary.
Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.

U.S.A. Stocks of Synthetic Rubber

(Long Tons)

Year	S-Types	Butyl	Neoprene	N-Type	Total
1944	122,412	9,992	12,262	5,366	150,032
1945	170,571	18,378	9,703	4,802	203,454
1946	83,090	19,478	10,470	3,755	116,793
1947	40,606	13,184	5,237	3,339	62,366
1948	96,304	10,995	5,072	2,762	115,133
1949	77,743	12,224	4,654	3,433	98,054
1950	36,942	7,243	5,733	2,840	52,758
1951	105,271	12,481	8,379	3,821	129,952
1952	83,861	22,716	8,535	3,875	118,987
1953					
Jan.	83,921	21,096	9,001	3,857	117,875
Feb.	81,550	19,560	9,078	3,911	114,099
Mar.	84,013	19,581	8,738	3,757	116,089
Apr.	89,839	19,144	9,364	3,694	122,041
May	100,873	18,376	8,986	3,874	132,109
June	112,770	18,141	9,073	3,805	143,789
July	127,278	18,280	10,036	3,892	159,486
Aug.	134,936	20,269	10,008	3,939	169,152
Sept.	132,453	21,280	9,671	4,221	167,625
Oct.	129,655	22,435	10,138	4,496	166,724
Nov.	127,464	23,401	11,067	4,591	166,523
Dec.	135,153	24,866	11,480	4,346	175,845
1954					
Jan.	138,692	24,733	13,065	4,349	180,839
Feb.	143,202	23,573	12,518	4,112	183,405
Mar.	145,178	22,329	12,575	4,202	184,284
Apr.	136,446	21,673	12,665	4,199	174,983
May	131,604	20,077	11,467	4,435	167,583
June	124,678	17,534	10,646	4,314	157,172
July	128,752	18,150	11,315	4,727	162,944
Aug.	135,164	19,672	10,710	4,613	170,159
Sept.	128,313	18,513	10,288	4,548	161,662
Oct.	127,204	18,653	11,038	4,272	161,167
Nov.	121,772	19,338	11,429	4,366	156,905
Dec.	115,499	19,267	11,349	4,280	150,395
1955					
Jan.	114,976	17,079	11,598	4,160	147,813
Feb.	111,796	15,424	10,555	3,885	141,660
Mar.	113,594	15,096	11,037	3,786	143,513
Apr.	112,156	14,813	10,863	3,586	141,418
May	114,216	14,449	10,283	4,033	142,981
June	108,679	13,053	9,755	3,883	135,370
July*	115,772	13,305	11,031	4,811	144,919

* Preliminary.
Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.

U.S.A. Imports and Production of Natural and Synthetic Latices

(Long Tons, Dry Weight)

Year	Natural	GR-S	Neoprene	N-Type	Total Synthetic	Total Natural & Synthetic
1942	9,595	....	210	....	210	9,805
1943	1,890	194	1,512	....	1,706	3,596
1944	3,090	6,580	4,683	....	11,263	14,353
1945	4,768	15,176	7,077	....	22,253	27,021
1946	8,012	24,810	13,595	....	38,405	46,417
1947	17,675	22,474	6,089	....	28,563	46,238
1948	32,630	21,494	5,022	....	26,516	59,146
1949	29,974	21,357	3,651	....	25,008	54,982
1950	54,401	31,339	5,725	....	37,064	91,465
1951	54,963	32,972	6,866	2,948	42,786	97,749
1952	48,228	42,273	7,598	4,164	54,035	102,263
1953	75,511	48,112	9,026	5,844	62,982	138,493
1954						
Jan.	5,396	4,089	592	471	5,152	10,548
Feb.	5,681	3,928	742	375	5,045	10,726
Mar.	5,682	4,142	709	483	5,334	11,016
Apr.	5,663	4,046	803	461	5,310	10,973
May	3,806	3,839	680	623	5,142	8,940
June	6,590	4,019	620	585	5,224	11,814
July	5,181	2,589	448	643	3,680	8,861
Aug.	7,571	1,995	756	682	3,433	11,004
Sept.	6,480	4,190	676	581	5,447	11,927
Oct.	7,210	5,190	742	780	6,712	13,922
Nov.	6,335	5,115	717	558	6,390	12,725
Dec.	8,888	5,238	729	624	6,591	15,479
Total	74,483	48,379	8,214	6,866	63,459	137,942
1955						
Jan.	7,853	6,199	617	624	7,440	15,293
Feb.	6,110	5,634	797	641	7,072	13,182
Mar.	7,611	7,078	854	672	8,604	16,215
Apr.	8,550	5,680	975	1,022	7,677	16,227
May	8,849	5,292	880	808	6,980	15,829
June	7,736	4,688	905	1,434	7,027	14,763
July*		4,753	641	993	6,387	

* Preliminary.
Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.

U.S.A. New Supply, Consumption, Exports, and Stock of Reclaimed Rubber

(Long Tons)

Year	New Supply	Consumption	Exports	Stocks
1942	286,007	254,820	30,405	42,532
1943	304,058	291,082	15,678	46,201
1944	260,631	251,083	11,800	43,832
1945	243,309	241,036	13,413	28,155
1946	295,612	275,410	14,461	33,666
1947	291,395	288,395	14,556	35,943
1948	266,861	261,113	11,428	32,630
1949	224,029	222,679	10,367	28,263
1950	314,008	303,733	11,740	35,708
1951	366,700	346,121	14,722	45,082
1952	274,981	280,002	11,180	30,664
1953	298,336	285,050	11,397	32,319
1954				
Jan.	20,026	19,114	912	31,865
Feb.	21,122	19,461	941	32,393
Mar.	23,383	22,882	830	32,148
Apr.	21,658	21,883	1,050	31,359
May	21,316	20,436	1,071	31,105
June	22,342	22,321	1,068	30,845
July	18,041	16,301	586	31,304
Aug.	15,519	17,660	647	27,692
Sept.	22,352	19,926	641	29,632
Oct.	23,566	22,098	808	30,395
Nov.	22,986	22,321	862	29,451
Dec.	25,790	24,546	816	30,746
Total	258,101	249,049	10,232	
1955				
Jan.	25,336	25,322	1,041	29,656
Feb.	25,444	24,333	1,085	30,125
Mar.	29,574	28,674	1,088	30,311
Apr.	26,817	26,609	1,088	30,068
May	27,911	27,652	1,056	29,528
June	30,451	29,157	1,128	29,725
July*	24,051	22,684	1,092	29,811

* Preliminary.
Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.

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COUMARONE RESINS
RECLAIMING OILS
PLASTICIZERS
POWDERED RUBBER

U.S.A. Exports of Synthetic Rubber

(Long Tons)

Year	S-Types	Butyl	Neoprene	N-Type	Total
1942	222	....	1,037	160	....
1943	14,937	40	2,540	631	17,608
1944	98,380	530	4,799	557	104,266
1945	76,555	980	5,837	406	83,778
1946	68,763	495	2,642	797	72,697
1947	7,951	62	2,617	755	11,385
1948	1,093	21	2,875	885	4,874
1949	1,401	178	3,330	1,574	6,483
1950	900	31	4,826	1,895	7,652
1951	483	216	6,825	1,725	9,249
1952	9,467	126	9,813	2,695	22,101
1953	7,692	237	11,494	3,245	22,668
1954					
Jan.	618	0	434	295	1,347
Feb.	508	2	1,251	287	2,048
Mar.	1,265	416	930	288	2,899
Apr.	520	62	1,296	454	2,332
May	1,115	373	844	395	2,727
June	881	216	694	215	2,006
July	1,126	421	1,220	358	3,125
Aug.	1,314	384	945	307	2,950
Sept.	785	53	978	270	2,086
Oct.	1,284	189	1,301	455	3,229
Nov.	659	575	1,081	435	2,750
Dec.	994	140	1,088	396	2,618
Total	11,069	2,831	12,062	4,155	30,117
1955					
Jan.	1,381	716	1,046	194	3,337
Feb.	1,331	370	1,049	259	3,009
Mar.	2,162	672	1,287	236	4,357
Apr.	1,807	1,562	1,636	506	5,511
May	3,500	376	1,430	357	5,663
June	6,030	726	1,541	389	8,686
July*	4,765	551	1,486	373	7,175

* Preliminary.

Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.

U.S.A. Consumption of Natural and Synthetic Latices

(Long Tons, Dry Weight)

Year	Natural	GR-S	Neoprene	N-Type	Total Synthetic	Total Natural & Synthetic
1942	9,392	....	200	....	200	9,592
1943	9,578	150	1,400	....	1,550	11,128
1944	6,085	6,000	4,400	....	10,400	16,485
1945	3,886	14,500	6,800	....	21,300	25,186
1946	5,714	23,500	13,000	....	36,500	42,214
1947	13,909	22,500	6,500	....	29,000	42,909
1948	28,489	21,500	5,250	....	26,750	55,239
1949	36,117	21,500	3,750	....	25,250	61,367
1950	56,138	31,000	5,500	....	36,500	92,638
1951	46,750	31,031	6,279	2,628	39,938	86,688
1952	53,567	40,562	7,368	3,093	51,023	104,590
1953	67,375	46,473	7,981	3,654	58,108	125,483
1954						
Jan.	5,882	3,475	615	275	4,365	10,247
Feb.	5,595	3,568	575	250	4,393	9,988
Mar.	6,610	3,982	729	335	5,046	11,656
Apr.	5,892	3,748	603	324	4,675	10,567
May	5,969	3,394	586	348	4,328	10,297
June	5,884	3,653	629	402	4,684	10,568
July	4,298	2,587	482	296	3,365	7,663
Aug.	5,228	2,834	561	351	3,746	8,974
Sept.	6,903	3,599	628	379	4,606	11,509
Oct.	7,527	4,347	612	376	5,335	12,862
Nov.	7,622	4,411	631	411	5,453	13,075
Dec.	7,671	4,575	600	460	5,635	13,306
Yr.-end adj.	+350	....	....	+300	....	....
Total	75,931	44,173	7,251	4,507	55,931	131,862
1955						
Jan.	7,355	4,537	661	506	5,704	13,059
Feb.	7,066	4,881	689	501	6,071	13,137
Mar.	8,415	5,861	828	509	7,198	15,613
Apr.	7,732	5,209	748	601	6,558	14,290
May	6,643	4,278	768	493	5,989	12,632
June	6,589	4,885	722	587	6,194	12,783
July*	5,487	3,932	552	404	4,858	10,345

* Preliminary.

Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.

U.S.A. Automotive Inner Tubes

(Thousands of Units)

Year	Shipments: Original Equipment	Shipments: Replacement	Shipments: Export	Shipments: Total	Production	Inventory End of Period
1951	32,151	32,284	1,071	65,507	67,249	10,094
1952	29,451	32,985	1,014	63,449	65,073	12,036
1953	37,957	36,072	878	74,907	74,425	11,874
1954						
Jan.	2,884	3,892	58	6,834	5,395	10,107
Feb.	2,636	2,908	74	5,617	5,896	10,448
Mar.	3,165	2,774	74	6,013	6,399	10,869
Apr.	3,134	2,770	97	6,001	6,266	11,234
May	3,017	2,900	84	6,002	5,909	11,170
June	2,889	3,657	85	6,631	5,739	10,379
July	2,707	3,471	87	6,265	4,132	8,429
Aug.	2,174	3,504	69	5,747	3,773	6,588
Sept.	1,130	2,839	64	4,033	4,489	7,179
Oct.	429	2,566	92	3,087	3,953	8,313
Nov.	449	2,142	90	2,681	3,245	8,706
Dec.	476	2,019	74	2,569	3,201	9,299
Total	25,090	35,442	948	61,480	58,397	
1955						
Jan.	413	3,629	74	4,116	3,089	8,252
Feb.	352	2,430	80	2,862	2,850	8,243
Mar.	491	2,732	105	3,328	3,234	8,217
Apr.	530	2,635	85	3,250	2,836	7,963
May	531	2,617	85	3,233	3,005	7,735
June	477	3,003	85	3,565	3,136	7,326
July	475	2,915	60	3,450	2,768	6,664

Source: The Rubber Manufacturers Association, Inc.

World Position of Natural Rubber Since 1910

Year	Total Production*	Total Consumption	Total Stocks	N. Y. Average Price—¢†
1910	95,000	100,000	....	102.84
1911	95,000	100,000	....	82.95
1912	115,000	120,000	....	80.37
1913	120,000	130,000	....	65.38
1914	122,500	120,000	....	49.03
1915	170,000	160,000	....	49.67
1916	215,000	185,000	....	58.85
1917	277,500	222,500	....	57.18
1918	220,000	235,000	....	44.84
1919	400,000	312,500	....	40.17
1920	342,500	297,500	....	42.79
1921	302,500	277,500	....	16.35
1922	402,500	405,000	....	17.34
1923	405,000	445,000	....	29.55
1924	422,500	465,000	....	26.07
1925	527,500	552,500	....	72.46
1926	625,000	542,500	....	49.36
1927	610,000	595,000	....	37.81
1928	655,000	685,000	....	22.33
1929	870,000	805,000	....	20.48
1930	825,000	710,000	....	10.24
1931	802,500	682,500	....	6.12
1932	710,000	690,000	....	3.43
1933	852,500	822,500	....	5.90
1934	1,032,500	920,000	....	12.94
1935	830,000	940,000	....	12.32
1936	867,500	1,045,000	....	16.43
1937	1,210,000	1,090,000	745,000	19.37
1938	910,000	955,000	707,500	14.56
1939	1,000,000	1,105,000	582,500	17.47
1940	1,417,500	1,110,000	880,000	19.90
1941	1,600,000	1,240,000	1,230,000	22.11
1942	640,000	765,000	1,020,000	22.50
1943	465,000	615,000	820,000	22.50
1944	360,000	387,500	715,000	22.50
1945	250,000	262,500	660,000	22.50
1946	837,500	555,000	940,000	22.50
1947	1,260,000	1,110,000	845,000	20.97
1948	1,525,000	1,422,500	770,000	22.01
1949	1,490,000	1,437,500	720,000	17.56
1950	1,860,000	1,705,000	767,500	41.10
1951	1,885,000	1,497,500	812,500	‡59.07
1952	1,790,000	1,455,000	822,500	§38.57
1953	1,725,000	1,630,000	830,000	24.23
1954	1,802,500	1,765,000	845,000	23.64

Production, consumption, and stock figures are in long tons and include latex (dry rubber content).

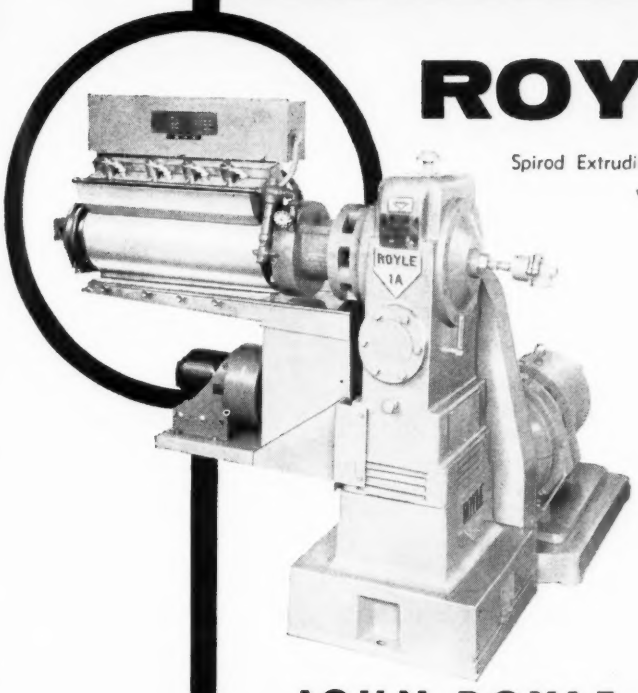
* Net exports up to and including 1936.

† Average import prices for U.S. up to 1921.

‡ Average of U.S. Government's selling price from January 8, 1951, onward.

‡ Average of U.S. Government's selling price until June 30, 1952, New York spot closing prices thereafter.

§ Source: "Rubber Statistical Bulletin" of International Rubber Study Group.



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Natural and Synthetic

Latex and Latex Compounds

for all purposes

World Production of Natural Rubber

(1,000 Long Tons)

Year	Malaya		Indonesia		All Other	Total
	Estate	Native	Estate	Native		
1947	360.5	285.8	12.8	265.2	335.7	1,260.0
1948	403.6	294.6	101.7	330.6	394.5	1,525.0
1949	400.8	270.7	169.1	263.9	385.5	1,490.0
1950	376.7	317.4	175.1	521.4	469.4	1,860.0
1951	328.8	276.5	222.5	591.9	465.3	1,885.0
1952	341.7	242.5	293.2	456.0	456.6	1,790.0
1953	341.8	232.6	301.8	390.4	458.4	1,725.0
1954						
Jan.	30.3	19.1	24.2	34.9	44.0	152.5
Feb.	25.4	18.0	23.0	30.2	30.9	127.5
Mar.	24.6	17.5	23.2	36.7	35.5	137.5
Apr.	24.8	15.4	21.2	37.0	34.1	132.5
May	27.6	18.6	22.9	32.9	30.5	132.5
June	27.0	16.3	21.0	33.5	39.7	137.5
July	31.0	23.0	26.8	46.2	38.0	165.0
Aug.	30.9	21.6	21.9	37.1	38.5	150.0
Sept.	30.1	23.4	23.6	46.4	41.5	165.0
Oct.	29.5	20.8	23.9	45.6	40.2	160.0
Nov.	31.9	22.9	24.3	36.8	46.6	162.5
Dec.	30.4	24.2	24.5	47.0	53.9	180.0
Total	343.5	240.8	280.5	464.3	473.4	1,802.5
1955*						
Jan.	29.3	27.9	23.6	17.1	42.1	140.0
Feb.	28.5	20.4	22.3	48.3	38.0	157.5
Mar.	27.5	26.7	23.0	24.3	38.5	140.0
Apr.	24.2	20.5	20.7	27.5	42.1	135.0
May	27.4	22.4	18.0	29.9	37.3	135.0
June	27.6	22.9	21.3	52.8	40.4	165.0

* Some figures revised.
Source: BDSA, United States Department of Commerce; Secretariat of the International Rubber Study Group; and United Baltic Corp., Ltd.

World Consumption of Natural Rubber

(1,000 Long Tons)

Year	United States	U.S.S.R.* and China	United Kingdom	Other Foreign	Total Foreign	Grand* Total
1947	562.7	57.2	153.6	336.5	547.3	1,100.0
1948	627.3	121.0	193.7	480.5	795.2	1,422.5
1949	574.5	132.5	184.3	546.2	863.0	1,437.5
1950	720.3	152.5	219.7	612.5	984.7	1,705.0
1951	454.0	136.3	234.2	675.5	1,046.0	1,500.0
1952	453.8	146.8	197.3	652.1	996.2	1,450.0
1953						
Jan.	47.8	10.8	17.9	58.5	87.2	135.0
Feb.	45.2	18.2	15.4	56.2	89.8	135.0
Mar.	50.7	18.5	15.6	60.2	94.3	145.0
Apr.	49.4	11.0	18.4	58.7	88.1	137.5
May	46.9	11.3	16.3	58.0	85.6	132.5
June	48.2	5.0	15.7	63.6	84.3	132.5
July	43.9	3.1	16.8	63.7	83.6	127.5
Aug.	43.7	2.0	14.2	55.1	71.3	115.0
Sept.	45.2	9.3	17.8	65.2	92.3	137.5
Oct.	46.8	3.8	21.3	65.6	90.7	137.5
Nov.	43.3	4.4	20.2	82.1	106.7	150.0
Dec.	42.4	4.5	17.0	66.1	87.6	130.0
Total	553.5	101.9	206.6	753.0	1,061.5	1,615.0
1954						
Jan.	47.0	7.8	20.3	67.4	95.5	142.5
Feb.	46.9		17.5	70.6	88.1	135.0
Mar.	53.7	2.7	19.1	72.0	93.8	147.5
Apr.	51.4	15.5	19.7	68.4	103.6	155.0
May	51.4	1.1	18.8	66.2	86.1	137.5
June	54.2	3.6	18.0	64.1	85.7	140.0
July	37.9	0.8	17.7	68.6	87.1	125.0
Aug.	38.1	8.9	14.2	63.8	86.9	125.0
Sept.	52.4	11.5	19.3	71.8	102.6	155.0
Oct.	56.0	3.5	23.1	74.9	101.5	157.5
Nov.	53.3	2.3	19.2	75.2	96.7	150.0
Dec.	55.2	5.0	19.6	72.7	97.3	152.5
Total	597.5	62.7	226.5	835.7	1,124.9	1,725.0
1955†						
Jan.	56.9	7.8	22.7	72.9	103.4	160.0
Feb.	51.0		19.5		91.5	142.5
Mar	58.5	7.3	20.8	78.1	104.6	162.5
Apr.	53.0		23.3		104.6	160.0
May	54.7		20.5		105.3	160.0
June	56.3	2.8	18.3	82.6	103.7	160.0
July	46.4					

* Estimated.
† Some figures revised.
Source: BDSA, United States Department of Commerce; Secretariat of the International Rubber Study Group; and United Baltic Corp., Ltd.

World Production of Synthetic Rubber

(1,000 Long Tons)

Year	U.S.A.	Canada	Germany*	Total
1951	845.2	62.3	0.9	908.4
1952	798.6	74.3	4.9	877.8
1953	848.4	80.9	6.3	935.6
1954				
Jan.	57.3	7.3	0.4	65.0
Feb.	53.4	6.7	0.4	60.5
Mar.	55.8	7.4	0.5	63.7
Apr.	47.6	7.1	0.6	55.3
May	46.6	7.3	0.5	54.4
June	45.9	5.9	0.5	52.3
July	47.0	5.8	0.5	53.3
Aug.	48.8	7.3	0.7	56.8
Sept.	51.4	7.9	0.6	59.9
Oct.	55.6	8.0	0.6	64.2
Nov.	55.0	8.0	0.7	63.7
Dec.	58.5	7.9	0.9	67.3
Total	622.9	86.6	6.9	716.4
1955				
Jan.	69.9	8.1	0.9	78.9
Feb.	67.7	7.6	0.9	76.2
Mar.	78.5	8.7	0.8	88.0
Apr.	75.7	7.6	0.8	84.1
May	82.0	8.9	0.9	91.7
June	78.2	8.6	....	....

Source: Secretariat of the International Rubber Study Group; and BDSA, United States Department of Commerce.
* British Zone only from 1945 to 1947; Bizone for 1948 and 1949; Federal Republic since 1950.

World Consumption of Synthetic Rubber*

(1,000 Long Tons)

Year	U.S.A.	Canada	United Kingdom	Total† Continent of Europe	World† Grand Total
1951	758.9	26.4	3.9	22.3	812.5
1952	807.0	33.6	4.9	35.0	885.0
1953	784.8	35.9	4.9	39.3	872.5
1954					
Jan.	50.2	2.6	0.6	3.8	57.5
Feb.	49.1	3.0	0.5	4.0	57.5
Mar.	56.1	2.9	0.7	4.3	65.0
Apr.	53.6	2.7	0.8	4.0	62.5
May	52.6	2.7	0.7	4.0	60.0
June	57.2	2.8	0.7	4.3	67.5
July	41.5	1.9	0.6	4.3	50.0
Aug.	42.1	2.0	0.7	3.5	47.5
Sept.	53.9	2.4	0.8	4.5	62.5
Oct.	58.3	2.1	1.0	4.3	67.5
Nov.	57.3	2.6	0.8	4.5	65.0
Dec.	64.1	2.4	0.8	4.5	72.5
Total	636.7	30.1	8.7	50.8	740.0
1955					
Jan.	68.4	2.6	1.2	5.0	77.5
Feb.	67.6	3.1	1.1	4.8	80.0
Mar.	77.1	3.4	1.2	5.3	87.5
Apr.	72.1	3.0	1.5	5.3	82.5
May	75.4	3.3	1.4	5.5	87.5
June	79.5	3.8	1.5	....	90.0

Source: Secretariat of the International Rubber Study Group; BDSA, United States Department of Commerce.
* Includes latices.
† Figures estimated or partly estimated.

U.S.A. Rubber Industry Sales and Inventories

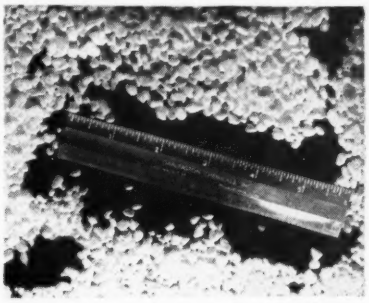
(Million of Dollars)

	Value of Sales*				Manufacturers' Inventories*			
	1952	1953	1954	1955	1952	1953	1954	1955
Jan.	408	424	348	405	809	866	844	798
Feb.	402	435	351	440	842	868	857	782
Mar.	400	473	388	466	857	880	849	805
Apr.	407	444	375	445	850	874	812	784
May	402	422	357	465	855	888	810	810
June	409	436	377	465	851	914	829	850
July	377	448	374	....	890	925	784	....
Aug.	388	409	337	....	877	897	761	....
Sept.	427	416	334	....	871	908	804	....
Oct.	423	395	332	....	866	881	838	....
Nov.	383	346	388	....	850	867	819	....
Dec.	418	369	407	....	877	868	929	....
Total	4,844	5,017	4,368	....	Av. 858	853	831	....

* Adjusted for seasonal variation.
Source: Office of Business Economics, U. S. Department of Commerce.

To Eliminate Dust and Cut Costs

IN NEOPRENE COMPOUNDING



Use DCI

"Tested and Proved"

GRANULAR LIGHT CALCINED MAGNESIA

Here is magnesia of the highest quality in granular form —practically dust-free. Each particle is uniform in crystal structure and chemical content. Strict manufacturing standards and quality control are your assurance of the cleanest and finest magnesia with low iron, calcium and manganese oxides content.

Additionally, protective packaging seals out dust and moisture. All of this means you get the important qualities in magnesia for neoprene compounding without paying a premium. Ask for a sample today. Test and you'll know. Write:

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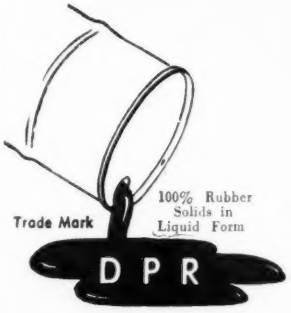
DPR®

Depolymerized Rubber



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100% ALL RUBBER SOLIDS

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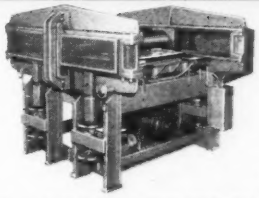
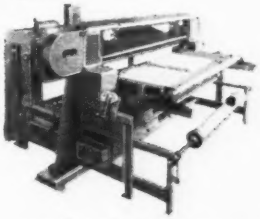
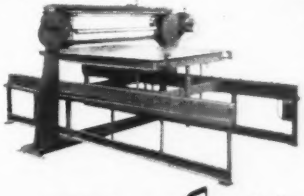
Campbell SPECIAL MACHINES



Campbell **ROLLER DIE CUTTER,** standard and heavy duty models. Die cuts many materials, trims molded rubber goods.



Campbell **FOAM RUBBER SPLITTER** for natural and synthetic foam, other materials. Splits most stock to 1/8" thickness.



Campbell **FOAM RUBBER CUSHION CUTTER** best for fabricating cushioning and seating material and for leveling stock before splitting.

Call, write or wire TODAY!

The FALLS ENGINEERING AND MACHINE CO.

Est. 1917

1734 FRONT ST., CUYAHOGA FALLS, O.

U.S.A. Automotive Pneumatic Casings

(Thousands of Units)

	Shipments					
	Original Equipment	Replacement	Export	Total	Production	Inventory End of Period
Passenger Car						
1949	28,129	36,440	509	65,077	65,140	8,904
1950	36,678	47,103	642	84,423	78,598	3,050
1951	26,729	34,226	723	61,678	65,546	6,973
1952	24,106	45,458	741	70,305	74,341	11,251
1953	33,106	45,798	809	79,713	81,455	13,044
1954						
Jan.	2,549	3,378	59	5,986	5,251	12,279
Feb.	2,323	3,001	60	5,384	5,952	12,832
Mar.	2,809	3,753	45	6,607	6,878	13,112
Apr.	2,785	4,328	95	7,208	7,031	12,955
May	2,695	4,503	101	7,300	6,985	12,575
June	2,587	5,326	89	8,002	7,755	12,323
July	2,516	5,222	73	7,812	5,605	10,063
Aug.	2,283	4,605	73	6,961	4,709	7,797
Sept.	1,375	3,825	73	5,273	6,242	8,950
Oct.	1,617	3,422	81	5,120	6,702	10,531
Nov.	2,823	2,844	91	5,758	6,480	11,331
Dec.	3,383	2,845	87	6,315	7,215	12,228
Total	29,746	47,043	928	77,717	76,806	
1955						
Jan.	3,481	4,139	79	7,699	7,797	12,363
Feb.	3,540	3,551	83	7,174	7,549	12,643
Mar.	4,326	4,255	104	8,685	8,810	12,874
Apr.	3,967	4,677	88	8,733	8,000	12,197
May	3,871	4,705	87	8,663	8,742	12,235
June	3,482	5,399	97	8,979	9,383	12,698
July	3,461	4,802	76	8,339	7,893	12,199
Truck and Bus						
1949	3,456	7,026	958	11,440	11,228	1,734
1950	4,671	9,705	788	15,164	14,156	743
1951	5,424	10,386	954	16,764	17,859	1,791
1952	5,378	8,884	779	15,041	16,070	2,859
1953	4,843	9,326	734	14,904	14,696	2,676
1954						
Jan.	342	615	59	1,016	1,048	2,698
Feb.	311	556	57	924	1,089	2,877
Mar.	354	597	71	1,022	1,103	2,966
Apr.	346	607	81	1,035	1,034	2,951
May	324	612	83	1,020	980	2,928
June	303	703	71	1,076	1,041	2,895
July	265	725	82	1,073	755	2,577
Aug.	243	824	51	1,118	717	2,188
Sept.	227	711	57	995	1,037	2,233
Oct.	251	828	66	1,145	1,167	2,268
Nov.	301	716	67	1,084	1,145	2,345
Dec.	325	625	81	1,031	1,229	2,546
Total	3,592	8,111	826	12,529	12,347	
1955						
Jan.	303	827	81	1,211	1,243	2,586
Feb.	294	730	74	1,098	1,196	2,678
Mar.	454	672	96	1,222	1,273	2,734
Apr.	489	639	76	1,204	1,153	2,693
May	481	655	65	1,202	1,208	2,701
June	449	730	76	1,255	1,320	2,763
July	429	909	51	1,389	1,134	2,485
Total Automotive						
1949	31,584	43,466	1,467	76,517	76,369	10,638
1950	41,349	56,808	1,430	99,587	92,754	3,794
1951	32,153	44,612	1,677	78,442	83,405	8,765
1952	29,484	54,342	1,520	85,346	90,411	14,110
1953	37,949	55,124	1,543	94,617	96,150	15,720
1954						
Jan.	2,891	3,993	118	7,002	6,299	14,977
Feb.	2,634	3,557	117	6,308	7,042	15,709
Mar.	3,163	4,350	116	7,629	7,981	16,077
Apr.	3,131	4,935	176	8,243	8,065	15,906
May	3,020	5,115	184	8,319	7,965	15,504
June	2,890	6,029	160	9,079	8,796	15,218
July	2,782	5,948	155	8,884	6,360	12,640
Aug.	2,527	5,429	123	8,079	5,427	9,985
Sept.	1,602	4,537	130	6,269	7,279	11,184
Oct.	1,868	4,251	147	6,266	7,869	12,799
Nov.	3,124	3,560	158	6,842	7,626	13,676
Dec.	3,707	3,470	169	7,346	8,444	14,774
Total	33,338	55,154	1,754	90,246	89,153	
1955						
Jan.	3,785	4,967	159	8,911	9,040	14,949
Feb.	3,833	4,281	157	8,272	8,745	15,321
Mar.	4,780	4,926	201	9,907	10,083	15,609
Apr.	4,457	5,315	165	9,937	9,153	14,890
May	4,352	5,361	152	9,865	9,949	14,936
June	3,931	6,129	174	10,234	10,703	15,460
July	3,890	5,711	128	9,729	9,027	14,684

Source: The Rubber Manufacturers Association, Inc.

U.S.A. Rubber Industry Employment, Wages, Hours

Year	Production Workers (1000's)	Average Weekly Earnings	Average Weekly Hours	Average Hourly Earnings	Consumers Price Index
All Rubber Products					
1939	121	$27.84	39.9	$0.75	....
1952	212	74.48	40.7	1.83	113.5
1953	221	77.78	40.3	1.93	114.4
1954					
Mar.	199.4	74.31	38.5	1.93	114.8
Apr.	195.2	75.08	38.7	1.94	114.6
May	197.0	77.81	39.7	1.96	115.0
June	198.4	79.60	40.2	1.98	115.1
July	173.1	76.83	39.4	1.95	115.2
Aug.	177.0	76.25	39.1	1.95	115.0
Sept.	198.9	77.81	39.3	1.98	114.7
Oct.	204.2	81.20	40.4	2.01	114.5
Nov.	204.6	83.02	41.1	2.02	114.6
Dec.	209.3	85.07	41.7	2.04	114.3
1955					
Jan.	210.5	84.25	41.3	2.04	114.3
Feb.	210.4	84.25	41.3	2.04	114.3
Mar.	211.2	83.44	40.9	2.04	114.3
Apr.	211.6	86.11	41.8	2.06	114.2
May	214.4	86.94	41.8	2.08	114.2
June	220.0	....	....	....	114.4
Tires and Tubes					
1939	54.2	$33.36	35.0	$0.96	
1952	92.9	85.65	40.4	2.12	
1953	93.0	88.31	39.6	2.23	
1954					
Mar.	84.7	80.89	36.6	2.21	
Apr.	83.2	84.14	37.9	2.22	
May	83.9	88.65	39.4	2.25	
June	85.0	92.06	40.2	2.29	
July	67.3	87.01	38.5	2.26	
Aug.	68.0	85.65	37.4	2.29	
Sept.	85.2	86.18	38.3	2.25	
Oct.	86.5	90.39	39.3	2.30	
Nov.	83.7	94.54	40.4	2.34	
Dec.	87.0	98.18	41.6	2.36	
1955					
Jan.	87.6	97.41	41.1	2.37	
Feb.	86.5	96.46	40.7	2.37	
Mar.	87.4	95.27	40.2	2.37	
Apr.	88.4	101.28	42.2	2.40	
May	90.1	100.91	41.7	2.42	
Rubber Footwear					
1939	14.8	$22.80	37.5	$0.61	
1952	22.9	62.22	40.4	1.54	
1953	23.7	65.60	40.0	1.64	
1954					
Mar.	19.6	65.51	39.7	1.65	
Apr.	19.2	63.58	38.3	1.66	
May	19.8	65.46	39.2	1.67	
June	19.8	67.30	40.3	1.67	
July	20.1	68.45	40.5	1.69	
Aug.	20.5	66.40	40.0	1.66	
Sept.	21.0	66.08	39.1	1.69	
Oct.	21.9	71.34	41.0	1.74	
Nov.	22.3	71.51	41.1	1.74	
Dec.	22.3	71.69	41.2	1.74	
1955					
Jan.	22.1	68.97	40.1	1.72	
Feb.	21.5	69.72	40.3	1.73	
Mar.	21.4	69.72	40.3	1.73	
Apr.	21.2	70.99	40.8	1.74	
May	21.4	70.64	40.6	1.74	
Other Rubber Products					
1939	51.9	$23.34	38.9	$0.61	
1952	96.0	66.58	41.1	1.62	
1953	104.1	70.93	41.0	1.73	
1954					
Mar.	95.1	70.22	39.9	1.76	
Apr.	92.8	69.30	39.6	1.75	
May	93.3	70.98	40.1	1.77	
June	93.6	70.98	40.1	1.77	
July	85.7	70.62	39.9	1.77	
Aug.	88.5	71.15	40.2	1.77	
Sept.	92.7	72.36	40.2	1.80	
Oct.	95.8	74.98	41.2	1.82	
Nov.	98.6	75.71	41.6	1.82	
Dec.	100.0	76.44	42.0	1.82	
1955					
Jan.	100.8	76.08	41.8	1.82	
Feb.	101.4	76.86	42.0	1.83	
Mar.	102.4	76.13	41.6	1.83	
Apr.	101.1	76.13	41.6	1.83	
May	105.0	78.31	42.1	1.86	

Source: BLS, United States Department of Labor.

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Lead & Zinc Compounds
meet the specific demands of the rubber industry . . .

Eagle-Picher manufactures a comprehensive line of both lead and zinc compounds for the rubber industry. Rigid product control is maintained from the ore to the finished product. More than a century of experience assures you of customer service unequalled in the field.

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Sublimed White Lead	Sublimed Blue Lead

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of the entire rubber industry

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of the industry's needs

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acknowledged superior by all users are important and valuable considerations to the consumer.

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Rubber Molds Cleaned And Brightened BEST with Oakite RUSTRIPPER!

Iron rubber molds, heavily encrusted with silicone and carbon deposits, presented a difficult cleaning problem at one large plant. The local Oakite Man was consulted. After he had carefully analyzed the problem, he suggested soaking the molds in a solution of Oakite Rustripper for 20 minutes. The results were startling. Not only was every trace of deposit removed—even from the sharp corners and indentations—but the metal molds looked as if they had been hand-polished! For further details about revolutionary Rustripper, write Oakite Products, Inc., 47 Rector St., New York 6, N. Y.

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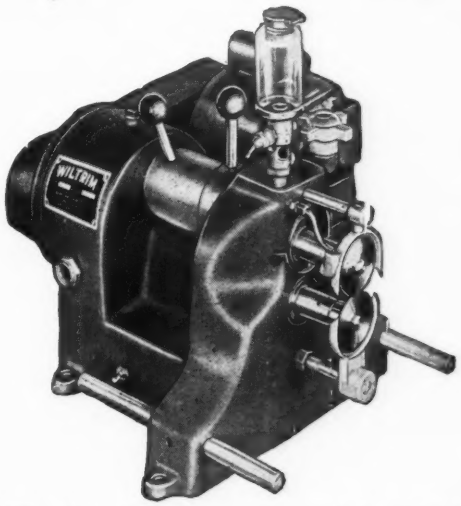
Model DF TRIMMER



Wills thirty-eight years experience brings you this outstanding successor to the famous earlier Models D, DE and DM trimmers.

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FERRY MACHINE COMPANY
WILLS RUBBER TRIMMING DIVISION
KENT, OHIO, U.S.A.
(Export Sales Through Binney & Smith, International)

Production of Cotton, Rayon, and Nylon Tire Fabrics

(Thousands of Pounds)

	Cotton				Rayon				
	Tire Cord Not Woven	Tire Cord Fabric Woven	Chafer and All Other Tire Fabrics	Total	Tire Cord Not Woven	Tire Cord and Other Tire Fabrics	Total	Nylon Tire Cord and Fabrics	Total* Synthetic Tire Cord and Fabrics
1952									
Jan.-Mar.	11,226	36,378	12,971	60,575	14,434	72,249	86,683	1,291	87,974
Apr.-June	4,661	24,612	10,742	40,015	16,874	81,249	98,123	1,463	99,586
July-Sept.	335	9,257	9,460	19,052	18,128	80,355	98,483	2,567	101,050
Oct.-Dec.	†	4,587	11,787	16,374	19,436	81,171	100,607	2,761	103,368
Total	15,887	74,834	48,280	139,001	68,873	315,024	383,897	8,082	391,979
1953									
Jan.-Mar.	‡	4,378	15,878	20,256	20,487	91,742	112,229	4,074	116,303
Apr.-June	‡	5,713	16,383	22,096	18,906	95,711	114,617	4,128	118,745
July-Sept.	‡	3,562	13,273	16,835	18,597	89,821	108,418	5,402	113,820
Oct.-Dec.	‡	2,460	11,569	14,029	19,664	74,013	93,677	5,246	98,923
Total	‡	16,113	57,103	73,216	77,654	351,287	428,941	18,850	447,791
1954									
Jan.-Mar.	‡	2,585	13,229	15,814	17,297	73,068	90,365	5,320	95,685
Apr.-June	‡	4,067	12,830	16,897	12,436	66,796	79,232	8,357	87,589
July-Sept.	‡	2,104	9,321	11,425	12,851	50,136	62,987	6,754	69,741
Oct.-Dec.	‡	3,743	12,476	16,219	14,609	76,931	91,540	9,338	100,878
Total	‡	12,499	47,856	60,355	57,193	266,931	324,124	29,769	353,893

	Cotton and Nylon[a]		Rayon Tire Cord		
	Cotton Chafer Fabrics and All Other Tire Fibers	Cotton and Nylon Tire Cord and Fabric	Woven	Not Woven	Total All Tire Cord and Fabrics
1955					
Jan.-Mar.	12,763	14,870	79,191	20,299	127,123
Apr.-June	12,728	18,527	80,908	21,550	133,713

* Fuel cell fabrics not included with rayon and nylon tire cord and fabrics.
† Included with "Chafer and All Other Tire Fabrics" to avoid disclosing data for individual mills.
‡ Included with "Tire Cord Fabric Woven" to avoid disclosing data for individual mills.
[a] Cotton and nylon figures combined to avoid disclosing data for individual companies.
Source: Bureau of the Census, United States Department of Commerce.

Carbon Black Statistics—First Seven Months, 1955

Furnace blacks are classified as follows: SRF, semi-reinforcing furnace black; HMF, high modulus furnace black; FEF, fast-extruding furnace black; HAF, high abrasion furnace black; SAF, semi-abrasion furnace black.

(Thousands of Pounds)

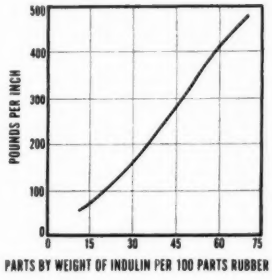
	Jan.	Feb.	Mar.	Apr.	May	June	July
Production							
Furnace types							
Thermal	9,315	8,269	10,317	10,620	12,094	12,077	12,189
SRF	25,099	26,162	26,258	25,634	24,974	26,561	28,371
HMF	9,060	7,610	8,538	7,644	7,665	7,015	8,700
FEF	12,395	11,597	14,943	17,039	19,196	19,013	18,938
HAF	33,199	29,344	34,011	35,341	36,249	37,238	39,592
SAF	15,627	18,010	18,139	17,201	15,699	14,494	12,260
Total furnace	104,695	100,992	112,206	113,479	115,877	116,398	120,050
Contact types	29,693	27,153	30,750	31,676	30,559	30,238	30,466
Totals	134,388	128,145	142,956	145,155	146,436	146,636	150,516
Shipments							
Furnace types							
Thermal	8,209	9,756	11,957	10,659	12,150	12,426	11,490
SRF	26,411	26,851	27,654	28,722	27,508	27,808	26,742
HMF	8,318	8,399	10,089	8,834	9,129	9,532	8,288
FEF	15,737	16,801	19,144	18,139	18,641	17,068	16,179
HAF	32,602	32,373	35,163	34,764	35,505	35,548	33,872
SAF	14,069	13,754	15,431	15,721	15,108	14,491	14,160
Total furnace	105,346	107,934	119,438	116,839	118,041	116,873	110,731
Contact types	43,403	35,263	42,107	39,827	37,073	36,697	33,228
Totals	148,749	143,197	161,545	156,666	155,114	153,570	143,959
Producers' Stocks, End of Period							
Furnace types							
Thermal	6,513	5,026	3,386	3,347	3,291	2,942	3,641
SRF	16,466	15,777	14,381	11,293	8,759	7,512	9,141
HMF	25,004	24,215	22,664	21,474	20,010	17,493	17,905
FEF	23,204	18,000	13,799	12,699	13,254	15,199	17,958
HAF	28,579	25,550	24,398	24,975	25,719	27,409	33,129
SAF	28,340	32,596	35,304	36,784	37,375	37,378	35,478
Total furnace	128,106	121,164	113,932	110,572	108,408	107,933	117,252
Contact types	172,647	164,537	153,180	145,029	138,515	132,056	129,294
Totals	300,753	285,701	267,112	255,601	246,923	239,989	246,546
Exports							
Furnace types	18,318	21,137	23,392	22,234	21,165	20,805	
Contact types	15,973	15,583	19,083	19,175	16,256	15,973	
Totals	34,291	36,720	42,475	41,409	37,421	36,778	

Source: Bureau of Mines, United States Department of the Interior, Washington, D. C.

POLYPOL S-70

for

TENSILE STRENGTH



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Even in conjunction with high loadings of filler pigments, good tensile strength is retained.

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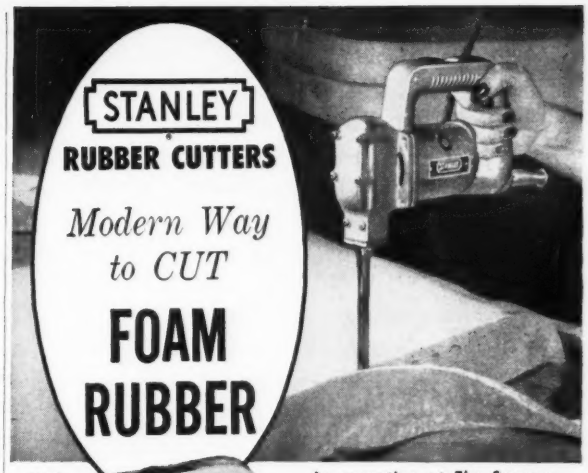

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U.S.A. Production and Sales of Elastomers*

	1953				1954			
		Sales				Sales		
	Production (1,000 Lbs.)	Quantity (1,000 Lbs.)	Value ($1,000)	Unit Value† (per Lb.)	Production (1,000 Lbs.)	Quantity (1,000 Lbs.)	Value ($1,000)	Unit Value† (per Lb.)
Cyclic Elastomers								
Polybutadiene-styrene type (GR-S, Buna S)								
Produced at government plants	1,413,097	....	....	....	966,813	1,022,276	238,504	$0.23
Private plants	1,847	....	....	....	6,436	6,249	3,915	0.63
TOTAL	1,414,944	1,387,198	319,056	$0.23	973,249	1,028,525	242,419	$0.24
Acyclic Elastomers								
Polybutadiene-acrylonitrile type (N-type)	45,244	42,758	21,586	$0.50	47,933	46,508	23,262	$0.50
Polychloroprene type (neoprene)	180,308	168,502	69,086	0.41	154,899	155,154	65,165	0.42
Polyisobutylene-isoprene type (GR-I, Butyl)	175,923	174,576	37,500	0.21	130,116	139,485	31,195	0.22
Polyvinyl type‡	118,364	112,940	65,374	0.58	104,973	104,298	58,046	0.56
All others§	23,567	22,819	16,762	0.73	23,792	22,557	15,871	0.70
TOTAL	543,406	521,595	210,308	$0.40	461,713	468,002	193,539	$0.41
TOTAL ALL ELASTOMERS	1,958,350	1,908,793	529,364	$0.28	1,434,962	1,496,527	435,958	$0.29

* An elastomer is defined as a material which can be stretched repeatedly to 150% or more of normal length and will return rapidly and with force to its approximate original state. † Calculated on round figures. ‡ Includes data for polyvinyl alcohol, butyral, and chloride elastomers.
§ Includes data for chlorinated and cyclo rubbers, polyurethane foams, and Thiokol, silicone, and polyisobutylene elastomers.
Source: United States Tariff Commission, Reconstruction Finance Corp., and United States Department of Commerce.

U.S.A. Production and Sales of Rubber-Processing Chemicals

	1953				1954			
		Sales				Sales		
	Production (1,000 Lbs.)	Quantity (1,000 Lbs.)	Value ($1,000)	Unit Value* (per Lb.)	Production (1,000 Lbs.)	Quantity (1,000 Lbs.)	Value ($1,000)	Unit Value* (per Lb.)
Cyclic Rubber-Processing Chemicals								
Accelerators†								
n-Butyraldehyde-aniline	374	333	187	$0.56	255	246	146	$0.59
Guanidines	6,167	5,206	2,620	0.50	....	....	....	....
Dithiocarbamic acid derivatives	....	....	....	....	203	193	368	1.91
Thiazole derivatives								
2,2′-Dithiobis[benzothiazole] (2,2′-Benzothiazyl disulfide)	14,860	10,053	4,609	$0.46	14,725	10,617	5,017	$0.47
2-Mercaptobenzothiazole	15,915	2,745	1,069	0.39	11,873	3,872	1,491	0.39
All others	21,994	11,176	5,925	0.53	20,408	10,328	5,514	0.53
TOTAL	52,769	23,974	11,603	$0.48	47,006	24,817	12,022	$0.48
All other accelerators	1,703	1,381	2,152	$1.56	5,852	6,264	4,701	$0.75
TOTAL	61,013	30,894	16,562	$0.54	53,316	31,520	17,237	$0.55
Antioxidants								
Amino or hydroxy compounds	23,893	22,419	12,756	$0.57	24,625	23,089	14,103	$0.61
All others	31,638	27,847	14,804	0.53	26,794	25,223	14,141	0.56
TOTAL	55,531	50,266	27,560	$0.55	51,419	48,312	28,244	$0.58
Peptizers, tackifiers, inhibitors, and blowing agents	4,988	4,335	3,470	$0.80	5,130	5,299	5,069	$0.96
TOTAL ALL CYCLIC RUBBER-PROCESSING CHEMICALS	121,532	85,495	47,592	$0.56	109,865	85,131	50,550	$0.59
Acyclic Rubber-Processing Chemicals								
Accelerators								
Dithiocarbamic acid derivatives‡								
Dibutyldithiocarbamic acid, zinc salt	766	637	600	$0.94	654	746	691	$0.93
Diethyldithiocarbamic acid, zinc salt	1,278	1,038	977	0.94	1,522	1,436	1,238	0.86
Dimethyldithiocarbamic acid, potassium salt	145	125	63	0.50	....	119	57	0.48
All others	4,084	1,114	1,017	0.91	3,373	1,076	986	0.92
TOTAL	6,273	2,914	2,657	$0.91	5,549	3,377	2,972	$0.88
Tetramethylthiuram sulfides§								
Tetramethylthiuram disulfide	4,719	2,995	3,214	$1.07	3,839	3,318	3,331	$1.01
Monosulfide	747	785	886	1.13	855	824	928	1.13
TOTAL	5,466	3,780	4,100	$1.08	4,694	4,142	4,259	$1.03
All others	4,420	3,850	2,117	$0.55	3,324	2,933	1,570	$0.54
TOTAL	16,159	10,544	8,874	$0.84	13,567	10,452	8,801	$0.84
Peptizers, lubricating, conditioning, and blowing agents								
Dodecyl mercaptans	6,118	6,413	3,244	$0.51	3,843	3,638	1,934	$0.53
All others	975	769	345	0.45	1,966	1,787	866	0.48
TOTAL	7,093	7,182	3,589	$0.50	5,809	5,425	2,800	$0.52
TOTAL ALL ACYCLIC RUBBER-PROCESSING CHEMICALS	23,252	17,726	12,463	$0.70	19,376	15,877	11,601	$0.73
TOTAL ALL RUBBER-PROCESSING CHEMICALS	144,784	103,221	60,055	$0.58	129,241	101,008	62,151	$0.62

* Calculated on round figures.
† Dithiocarbamic acid derivatives not included in 1953 table, since revealing these figures would disclose the production of an individual company, which is forbidden by law. Similarly, guanidine production has not been included in the 1954 table.
‡ Data on dithiocarbamates included in table are for material used exclusively in the processing of natural and synthetic rubbers.
§ Includes data for small amounts of tetramethylthiuram sulfides for uses other than in processing of natural and synthetic rubbers.
¶ Includes a small amount of tetraethylthiuram disulfide.
Source: United States Tariff Commission.

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SITUATIONS OPEN

RUBBER COMPOUNDING RESEARCH

PhD or equivalent for responsible position as manager of a Rubber Compounding Research Laboratory. Opportunity for fundamental work on new synthetic rubbers and reinforcing agents—integrated with an aggressive research and development program on synthetic rubber, including pilot plant and tire testing facilities. Send résumé to Box No. 1771, c/o RUBBER WORLD.

RUBBER CHEMISTS

Degree in chemistry or chemical engineering. Up to five years' experience in rubber and polymer processing, development or production. Progressive company, well-equipped laboratory; permanent position with opportunity for advancement in expanding operation. Write giving age, experience, and education. Replies held confidential. Address Box 369, Erie, Pennsylvania.

WANTED

MANUFACTURER'S AGENT for line of Neoprene and Hypalon protective coatings. Eastern seaboard and midwestern states. Address Box 1787, care of RUBBER WORLD.

CHEMIST OR CHEMICAL ENGINEER WITH BROAD EXPERIENCE wanted by leading manufacturer of non-woven bonded textiles. Write complete details. Address Box No. 1788, care of RUBBER WORLD.

PRESSURE-SENSITIVE TAPE CHEMIST

Progressive AAA1 manufacturer desires chemist with experience in developing and producing pressure-sensitive tapes—also development and compounding of adhesives for the same. Growth possibility for the right man. Send résumé and salary desired with first letter. All replies confidential. Our employes have been informed of this advertisement. Address Box No. 1789, care of RUBBER WORLD.

RUBBER PRODUCTS MANAGER

Molded Rubber Products Company, located in metropolitan Chicago area and employing some 200 people, is looking for plant manager with proved record of success. Working knowledge of molds is necessary. Salary plus generous incentive arrangement. Detailed resume is required and replies will be held in strictest confidence. Address Box No. 1786, c/o RUBBER WORLD.

CHEMICAL ENGINEER

By well-established New England Textile-Plastics concern to direct and supervise laboratory engaged in production control research, and product development and to assist plant manager in operation of factory using synthetic latex manufacturing procedures.

Must have B.S. or advanced degree with 5-8 years in the field of high polymer dispersions, combined with experience and knowledge of textile fibres.

Our employes know of this advertisement.

All replies will be held in strictest confidence.

Write full particulars including age, background, previous experience, and salary requirements to Box No. 1790, care of RUBBER WORLD.

DEPARTMENT MANAGER FOR MOLDED GOODS DEPARTment with well-known and well-established company. Applicant must be thoroughly acquainted with all phases of molded goods manufacturing and capable of reorganizing established department. Must be willing to relocate; salary commensurate with ability. Send résumé to Box No. 1791, care of RUBBER WORLD.

PERSONNEL SPECIALISTS TO THE RUBBER INDUSTRY

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SITUATIONS OPEN (Continued)

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Give full details on age, education, experience. Replies held confidential. Our employees know about this ad.
ADDRESS BOX NO. 1762, c/o RUBBER WORLD

RUBBER CHEMIST CALIFORNIA

Nationally known, medium size, first-rate western manufacturing company has challenging opening for a qualified Rubber Chemist. Essential qualifications are:

- **Considerable ingenuity and resourcefulness**
- **Ability to work well with others**
- **5-10 years' practical experience in rubber compounding and production**
- **Degree in chemistry**

Attractive salary depending on background and qualifications. Please submit biographical résumé to Box No. 1784, care of RUBBER WORLD.

RUBBER PROCESS ENGINEERS

Progressive midwest manufacturer of precision molded mechanical rubber goods has permanent and challenging opening for experienced graduate mechanical or chemical engineers. Experience preferred in mold design and in mechanical rubber seals and goods processing. Salary equal to experience and ability, excellent opportunity plus many paid benefits. Replies should be complete and will be held in strict confidence.

BOX No. 1785, c/o RUBBER WORLD

U.S.A. Production and Sales of Plasticizers

	1953				1954			
		Sales				Sales		
	Production (1,000 Lbs.)	Quantity (1,000 Lbs.)	Value ($1,000)	Unit Value* (per Lb.)	Production (1,000 Lbs.)	Quantity (1,000 Lbs.)	Value ($1,000)	Unit Value* (per Lb.)
Cyclic Plasticizers								
Phosphoric acid esters								
Tricresyl phosphate†	22,109	21,043	6,866	$0.33	23,847	24,533	7,740	$0.32
Triphenyl phosphate	7,418	3,289	1,206	0.37	6,426	3,454	1,255	0.36
TOTAL	29,527	24,332	8,072	$0.34	30,273	28,007	8,995	$0.33
Phthalic anhydride esters								
Bibutyl phthalate	23,280	18,256	5,372	$0.29	19,876	13,897	3,685	$0.27
Dicapryl phthalate	7,762	9,398	3,091	0.33	5,832	5,831	1,713	0.29
Diethyl phthalate	17,584	12,307	3,096	0.25	15,999	10,141	2,492	0.25
Di (2-methoxyethyl) phthalate (dimethyl cellosolve phthalate)	2,240	....	....	....	2,098	....	....	....
Dimethyl phthalate	2,508	2,734	696	0.25	2,557	2,328	598	0.26
Dioctyl phthalates								
Di (2-ethylhexyl) phthalate	51,281	38,640	13,704	0.35	54,067	41,471	12,494	0.30
Di-n-octyl, diiso-octyl, and mixed octyl phthalates	33,532	27,783	9,489	0.34	34,157	26,952	8,056	0.30
Octyl decyl phthalate	8,678	8,130	2,938	0.36	10,060	9,907	3,213	0.32
All others	18,372	15,664	6,137	0.39	25,964	23,500	8,421	0.36
TOTAL	165,237	132,912	44,523	$0.33	170,610	134,027	40,672	$0.30
All other cyclic plasticizers‡	29,046	22,893	7,360	$0.32	26,735	23,747	7,326	$0.31
TOTAL ALL CYCLIC PLASTICIZERS	223,810	180,137	59,955	$0.33	227,618	185,781	56,993	$0.31
Acyclic Plasticizers								
Adipic acid esters								
Di (2-ethylhexyl) adipate	3,497	2,045	896	$0.44	2,710	1,536	666	$0.43
Diiso-octyl adipate	1,511	1,276	589	0.46	884	1,221	552	0.45
All others	4,169	2,739	1,237	0.45	3,443	2,420	1,172	0.48
TOTAL	9,177	6,060	2,722	$0.45	7,037	5,177	2,390	$0.46
Lauric acid esters	113	106	42	$0.40	55	68	26	$0.38
Oleic acid esters								
Glyceryl trioleate (Triolein)§	3,214	3,323	838	$0.25	4,054	4,237	1,123	$0.27
All others	4,738	2,305	918	0.41	6,031	3,770	1,552	0.41
TOTAL	7,952	5,628	1,756	$0.31	10,085	8,007	2,675	$0.33
Phosphoric acid esters	8,534	6,398	2,898	$0.45	6,122	5,571	2,439	$0.44
Ricinoleic and acetylricinoleic acid esters	4,572	....	....	....	....	....	....	....
Sebacic acid esters								
Dibutyl sebacate	2,186	....	....	....	1,950	967	676	$0.70
Di (2-ethylhexyl) sebacate	2,498	2,432	1,736	$0.71	4,076	3,812	2,428	0.64
All others	1,017	1,987	1,809	0.91	540	667	581	0.87
TOTAL	5,701	4,419	3,545	$0.80	6,566	5,446	3,685	$0.68
Stearic acid esters								
Butyl stearate	2,417	2,121	471	$0.22	3,647	3,554	730	$0.21
All others	2,122	2,029	618	0.30	2,822	2,562	727	0.28
TOTAL	4,539	4,150	1,089	$0.26	6,469	6,116	1,457	$0.24
All other acyclic plasticizers¶	28,500	28,168	11,328	$0.40	36,722	31,279	12,332	$0.39
TOTAL ALL ACYCLIC PLASTICIZERS	69,088	54,929	23,380	$0.43	73,056	61,664	25,004	$0.41
TOTAL ALL PLASTICIZERS	292,898	235,066	83,335	$0.35	300,674	247,445	81,997	$0.33

* Calculated on round figures.
† Includes data for material reported for use as motor-fuel additive.
‡ Includes data for synthetic camphor, certain phosphoric acid esters, toluenesulfonamides, tetrahydrofurfuryl oleate, and other cyclic plasticizers.
§ Includes data for material reported for use as a surface-active agent.
¶ Includes data for citric and acetylcitric, palmitic, azelaic, tartaric, and ricinoleic acid esters, and for butyl myristate, glyceryl and glycol esters of certain fatty acids, glyceryl tripropionate, and complex polymeric plasticizers.
Source: United States Tariff Commission.

Statement of RUBBER WORLD

Statement required by the Act of August 24, 1912, as amended by the Acts of March 3, 1933, and July 2, 1946, (Title 39, United States Code, Section 233) showing the ownership, management, and circulation of RUBBER WORLD, published monthly at Philadelphia, Pa., for October, 1955.

1. The names and addresses of the publisher, editor, managing editor, and business manager are: publisher, Bill Brothers Publishing Corp., 386 Fourth Ave., New York 16, N. Y.; editor, Robert G. Seaman, 386 Fourth Ave., New York 16, N. Y.; managing editor, S. R. Hague, 386 Fourth Ave., New York 16, N. Y.; business manager, B. Brittain Wilson, 386 Fourth Ave., New York 16, N. Y.

2. The owner is: Bill Brothers Publishing Corp., Raymond Bill, Edward Lyman Bill, all at 386 Fourth Ave., New York 16, N. Y.

3. The known bondholders, mortgagees, and other security holders owning or holding 1% or more of total amount of bonds, mortgages, or other securities are: None.

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

B. BRITTAIN WILSON
Business Manager

Sworn to and subscribed before me this 20th day of September, 1955.

[Seal] JOSEPHINE M. CIERO

Notary Public in the State of New York. Qualified in Westchester, No. 60-0638500.

(Commission expires March 30, 1957)

New Cabot Project

Godfrey L. Cabot, Inc., Boston, Mass., has set up a new project department under financial vice president and treasurer, Louis W. Cabot, and directed by Stuart V. Stoddard. The new department will exploit the company's research and development activities.

SITUATIONS OPEN (Continued)

WANTED: RUBBER CHEMIST WITH EXPERIENCE IN OPEN and closed cell sponge and mechanicals. Plant located in East. Address Box No. 1792, care of RUBBER WORLD.

CHEMICALLY BLOWN SPONGE MAN WANTED FOR POSITION with midwest company. Production and development experience in sheet and continuous rolls from natural and synthetic rubbers essential to fill this position. Technical background preferred. Address Box No. 1793, care of RUBBER WORLD.

MANUFACTURER'S REPRESENTATIVE ON MOLDED SPECialties and lathe-cut goods to cover Eastern Markets on commission basis. MARTIN RUBBER COMPANY, Long Branch, New Jersey.

WANTED: MECHANICAL GOODS RUBBER COMPOUNDER. Minimum of 3 years in compounding and processing experience. Must be familiar with ASTM and SAE specifications and tests. Also familiar with extrusions. Will be in charge of compounding for mechanical goods division. Salary commensurate with ability. Give complete resumé of experience, etc., in first letter. Write L. E. Onecare, Cooper Tire & Rubber Co., Findlay, Ohio.

CHIEF RUBBER CHEMIST TO TAKE CHARGE OF OUR mechanical rubber goods compounding operation. Will report directly to our Technical Director and supervise the activities of our laboratory personnel. Salary open. Replies will be confidential. Contact: Personnel Manager, THE SUN RUBBER COMPANY, Barberton, Ohio.

CHEMICAL ENGINEER: RECENT GRADUATE TO WORK IN rubber footwear lab. Location eastern Mass. State full qualifications and requirements in first letter. Address Box No. 1796, care of RUBBER WORLD.

SITUATIONS WANTED

MOLDED AND SHEET SPONGE GOODS TECHNICAL MAN with 17 years' diversified experience in compounding, processing, development, plant management, and labor relations work. Also limited dense rubber experience. Am reliable, energetic, ambitious, 36 years old, and a family man. Have done some personnel work. Will relocate anywhere with a reliable, growing company. Address Box No. 1794, care of RUBBER WORLD.

RUBBER CHEMIST SIXTEEN YEARS' EXPERIENCE COMpounding, development, quality control supervisor, trouble shooting, physical testing supervisor—rubber cements, sponge, heels, soles, and soling slabs. Address Box No. 1795, care of RUBBER WORLD.

MACHINERY & SUPPLIES WANTED

WANTED: RUBBER MACHINERY INCLUDING BANBURY Mixers, heavy-duty Mixers, Calenders, Rubber Rolls & Mixers, Extruders, Grinders & Cutters, Hydraulic Equipment, Rotary and Vacuum Shelf Dryers, Injection Molding Machines. Will consider a now-operating or shut-down plant. P. O. Box 1351, Church Street Sta., New York 8, N. Y.

WANTED: 2 HYDRAUL. RUBBER SLAB PRESSES, UP MOVEment, stroke 24", ram 30-36" and 20", openings 8-9, steam platens 3" thick, platen sizes 42" x 42" or more, 1,000 ton on platen area for 30-36" ram or in similar sizes. 1 Splitter about 50" wide or more, with continuous knife. 1 Sander 48" appr. ALCO MACHINERY & SUPPLY CO., 5 Beekman Street, New York 38, N. Y.

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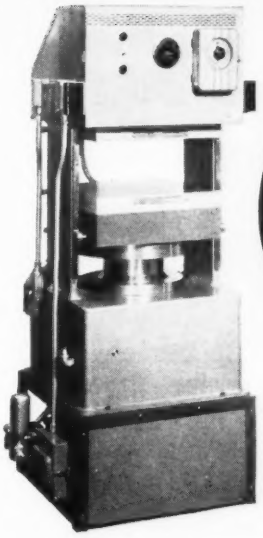
FARREL 16" X 48" AND 15" X 36" 2-ROLL RUBBER MILLS, AND sizes up to 84". New and used lab. 6" x 12" & 6" x 16" Mills and Calenders. Extruders 1" to 6". Baker-Perkins Jacketed Mixers 100, 50, and 9 gals. HPM 200-ton Hydr. Press 30" x 48" platens. Brunswick 200-ton 21" x 21" platens. 100-ton 20" x 20" platens. 150-ton 24" x 24" platens. Large stock Hydraulic Presses 12" x 12" to 48" x 48" platens. Hydraulic Pumps and Accumulators. Rotary Cutters. Stokes Molding Presses. Single Punch & Rotary Preform Machines. Banbury Mixers, Crushers, Churns, Bale Cutters, etc. SEND FOR SPECIAL BULLETIN. WE BUY YOUR SURPLUS MACHINERY. STEIN EQUIPMENT CO., 107—8th St., Brooklyn 15, N. Y. STerling 8-1944.

The **P·H·I** *Automatic 70 Ton Hydraulic Press*



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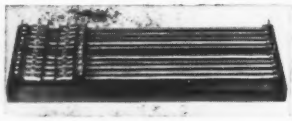

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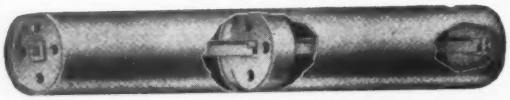

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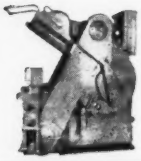

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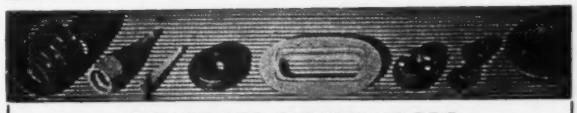

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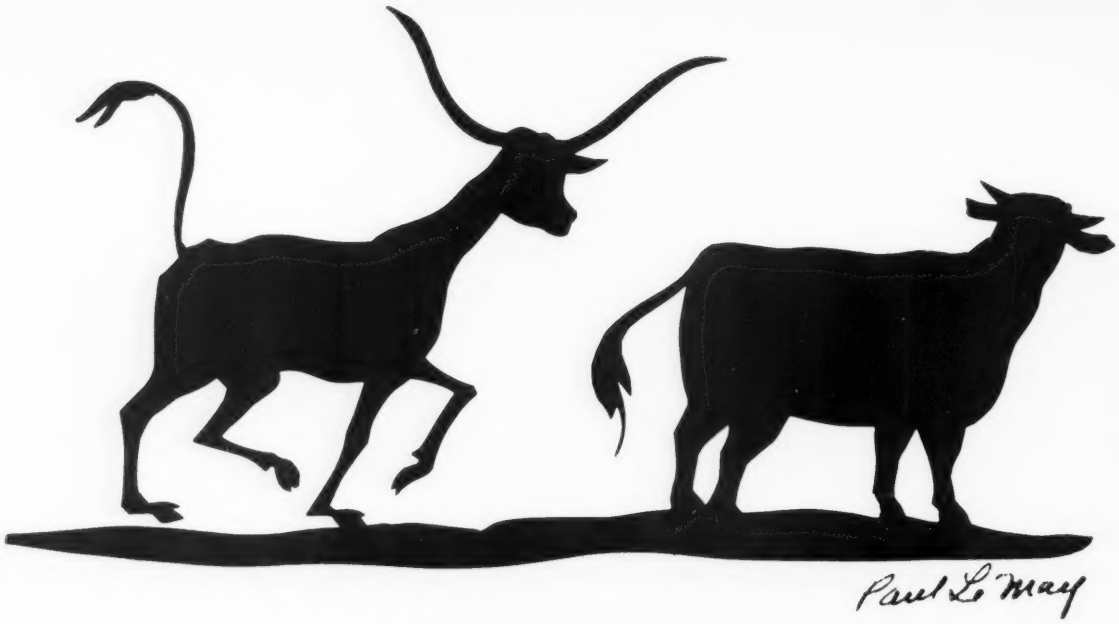

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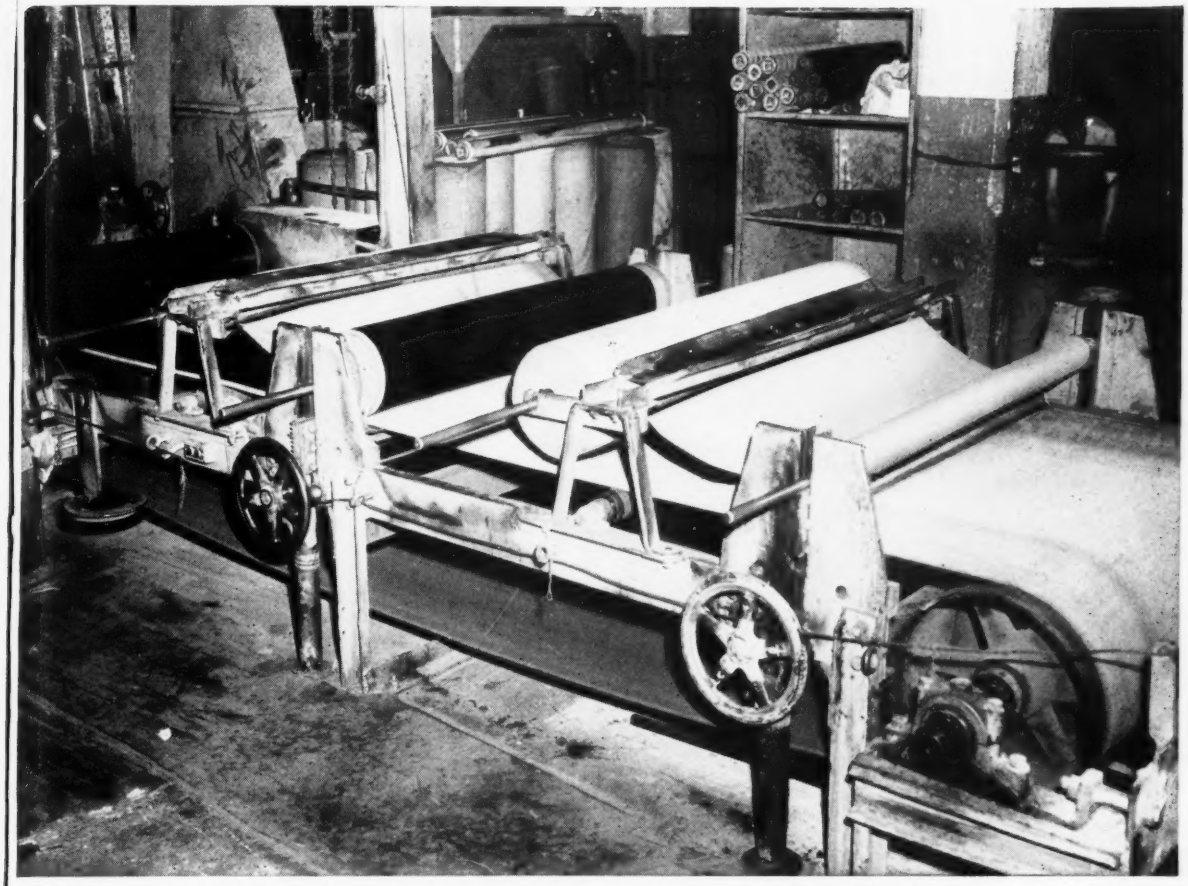

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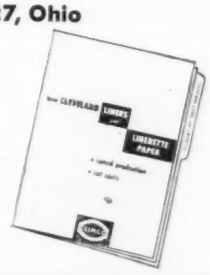

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